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FREIGHT TERMINAL AND TRAIN OPERATION

(M.B.A. THESIS)

TA-CHUN WU

1926

Preface.

The success which the railways have achieved during recent years in the handling of heavy traffic with comparatively small increase in facilities is particularly indicative of the value of a close study of train operation. Realizing that no M.B.A. student of our University has ever written anything on the operating aspect of railroading, the writer endeavors to plunge into this broad subject with no ambition as to claim an exhaustive study, but with the expectation that the fellow-graduate would take interest in it and cooperate in completing the study.

Aside from reading literature on this subject, both in the University Library and in the Library of the Bureau of Railway Economics, Washington, D.C., the writer was given an opportunity thru the kind assistance of Prof. G.G. Huebner, of making a thorough study of the Walnut-Dock St. Station, the Freight Yard at Fifty-second St., the Dispatcher's Office of the Philadelphia Terminal Division, P.R.R. and other places under the direction of the various officers of the Pennsylvania Railroad. To them he offers his hearty thanks.

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INTRODUCTION

The whole mechanism of the railroad is built not for the accomplishment of an engineering feat, but for the transportation of goods and persons in the most efficient manner and for the return of revenue in the largest possible amount.

The essence of efficiency in railroad operation is the attainment in the highest degree of ton-miles and passenger miles of the best possible quality and at the least practical cost.

On practically all of the railroads, freight is the important traffic from the standpoint of volume, and it is usually even more important from the standpoint of revenue. Unlike passengers, it requires greater care and more complicated processes in handling. Freight transportation is, therefore, worth greater consideration.

In conducting freight transportation with a view to the improvement of performance and reduction of expense, the traffic carrying capacity or train tonnage is the controlling factor which shall be principally emphasized. Any increase in traffic carrying capacity, or every ton which is added to the average freight train load, means a direct reduction in the operating ratio and a greater balance of revenue over expense.

The traffic carrying capacity can be enlarged in two principal ways, namely: (1) the improvement in the mechanico-physical aspect, and (2) the improvement in the working methods.

A railroad can be operated more efficiently, accommodating heavier traffic than usual, through the extension of running lines, sidings, and terminal facilities, or through the improvement in the speed or rate of movement of locomotives, trains, and traffic by the betterment in the mechanical appliances such as signals, brakes and tractive power used (electricity or steam).

On the other hand, the operating efficiency can also be attained through the improvement in working methods, in the way of increased freight train loads and by the exertion of more vigorous human energy in all directions.

The improvement in mechanico-physical aspects certainly has its merits and deserve consideration, in view of the present rapid increase in traffic and the great advancement in mechanical invention. This proposition, however, meets two strong objections, namely: (1) physical handicap and (2) financial inability.

Many railroads have terminal and roadway limitations, which render any extensive improvement impossible without relocation. Again, the physical or mechanical improvement always entails heavy capital expenditure. To roads of healthy financial standing, this might encounter less difficulty. But many railroads, under present condition, are not financially able to provide additional sidings or modern power. Their earnings are not sufficient to inspire investors with the necessary confidence to induce them to lend money for the improvements.

If the Potter Plan could be carried out, the condition might, perhaps, be different; the less fortunate roads might be able to secure funds for the purchase of equipment. In the meantime, however, it is necessary for many of the roads to struggle along as best they can with their present facilities.

This resorts to the second proposition: the improvement in the working methods. The latter involves no physical handicap nor heavy expenditure. It demands only human ingenuity, power and interest. All conditions may be favorable, all facilities provided, they remain to be operated by competent men with efficient methods.

All things being equal, the difference between competent and incompetent operation is certainly great. Professor W.J.Cunningham of Harvard University once spoke of the Central Vermont Railway, which once being dificient, through the emphasis and campaign on increasing "gross ton miles per train hour" and with the full interest and co-operation of its employes, was able to bring about substantial reduction in ton mile cost of fuel and wages, increase in the speed of movement of trains and cars, better train load, less delay, and a surprising increase in gross ton mile per train hour of 33.6% in the short period of one year(1923-1925).

It has also been mentioned by E.Cordeal, the author of Railroad Operation, that, "on one road which had not been making expense for a number of years, a tonnage campaign, which increased the net revenue train load by some twenty percent in the space of two years, and all-

out one cent of investment in new power or other facilities, was chiefly responsible for turning a bankrupt property into a dividend payer". It can be seen, therefore, how much can be done simply by improving the working methods.

In time of very heavy traffic, much has been heard about shortage in equipment and power. Whether there has ever been an actual shortage, it is doubtful. It is probable that any such instance is not true inadequacy in the amount of equipment and power available for use, but rather the failure to get the fullest possible service from such equipment. Again, the provision for equipment can hardly be expected to keep pace with the rapid increase of traffic. It is up to the management and the employes to devise the best methods and to cooperate in the work in order to arrive at the most economical and efficient operation.

The following chapters will be devoted to the methods of conducting freight terminal and train operation with little discussion on the mechanico-physical improvement of the railroads.

PART I. TERMINAL OPERATION

Chapter 1 Terminal Facilities

Definition and Classification of Terminals
Freight Yards
- Receiving Yard
- Classification Yard
- Departure Yard
- Yard Tracks
- Yard Appurtenances

Freight Stations
- Freight Houses, Inbound and Outbound
- Transfer Houses
- Platforms
- Warehouses
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- Stock Yards

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PART I TERMINAL OPERATION

CHAPTER I TERMINAL FACILITIES

A freight terminal is an assemblage of facilities provided by a railway at a terminus or at intermediate points on its line for the purpose of delivering, receiving and transferring freight traffic, and of assembling, assorting, classifying and relaying trains.

There are three principal classes of terminals, namely:

1 *Local Terminals* for handling traffic at a local or way station along a line of railway. Facilities at these saml terminals are simple and limited.

2 *Intermediate Terminals* for handling traffic at an intermediate point on a line of railway, such as a division, or district terminal.

3 *Final Terminals* for handling traffic at tdrminus of a division, district or line.

Any large freight terminal generally consists of the following facilities:[1] (1) freignt yards; (2) freight stations; (3) teamtrack delivery yards; (4) private and industry sidings; (5) rail and water terminals.

1 *Freight yards*---"A yard is a system of tracks within defined limits provided for receiving, making up and despatching trains, classifying, storing and forwarding cars, housing locomotives, and other

1 Dewsnup, E.R. *Railway Organization and Working* P. 175

purposes, over which movements not authorized by time tables or train orders may be made, subject to prescribed signals, rules and regulations."[2]

A freight yard unit consists of (1) a receiving yard, (2) a classification yard, (3) a departure yard, (4) a number of yard tracks and (5) the necessary appurtenances and equipment.

1 A receiving yard is one in which the inbound trains are received directly from the main line, and into which they are taken by the road crews, who are relieved at this point. The tracks in the receiving yard diverge from a common ladder track and are of a length to accommodate maximum trains and hold them without breaking up for sorting.

2 A classification yard comes next with lead-tracks directly connecting the tracks in the receiving yard. It is the working center of the freight yard, where cars are separated by a sub-classification,"Gridiron" or station-order-yard, into which cars are re-switched and assembled in station order.

There are three types of classification yards:

(1) A *Shunting Yard* is one "in which the trains are classified 'on the level' by the process of shunting or pushing and pulling alternately the cars by the switch engine."

(2) A *Poling Yard* is one "in which the classification is done on inclined tracks---the switch engine with a pole, running on a

1 *Manual of the American Railway Engineering Association.*

track parallel to the lead track, starts the cuts down the grade, whence they run by their combined momentum, aided by gravity, into the assigned tracks in the classification yard".

(3) A Summit- or Hump Yard is one "in which the cars are run to the summit of a grade, which rapidly descends into the classification yard, the cars, after being detached at the summit, running down under the action of gravity, into the assigned classification tracks." This type of yard permits the handling of a heavy volume of traffic and requires the least amount of time and expense. Track scales are usually located on the summit.

3 A departure yard is directly connected with the classification yard. Here the cars are made into trains ready for departure, and the work of the yard engines and their crews ceases and that of the road or transfer engines and their crews begins.

For the purpose of facilitating the movement of traffic constantly in the direction of its objective point avoiding false or backward movements, separate systems as above described are provided.--- one system for the traffic in one direction and a duplicate system for the traffic in the opposite direction.

4 Aside from the tracks in the receiving, classification, and departure yards, the following yard tracks are provided for various purposes.[1]

1 Manual of the American Railway Engineering Association
Coree, C.F. Railroad Freight Transporation: Permanent Ways P.8
Droege, J.A. Freight Terminals and Trains P.63

(1) Repair tracks connecting the classification and bad-order tracks for accommodating bad order cars and making light repairs;

(2) Storage tracks located alongside of the classification yard for holding cars for disposition, which will later be classified and rehandled thru the classification yard;

(3) Ladder tracks connecting successively the body tracks of the yard, body tracks being any parallel tracks of a yard upon which cars are switched or stored;

(4) Lead tracks connecting either end of a yard with the main track, for leading trains into or out of the yards and keeping the main tracks clear;

(5) Drill tracks connecting with the ladder tracks for movements in yard switching;

(6) Running tracks reserved for movements in a yard in either direction, enabling yard or road engine to pass freely from one position of the yard to the other;

(7) Cross-over tracks connecting two adjacent tracks;

(8) Relief tracks or extended sidings allowing an inferior train to continue running;

(9) Caboose tracks at the end of both the eastbound and westbound yards and connecting with the running tracks for attaching and detaching cabooses from the trains;

(10) Fuel tracks leading to company's sheds of fuel;

(11) Coaling, ashpit, sand, and engine tracks located on the

[illegible] leading to and from the engine house for the preparation of engines;

(12) Stock pen and icing tracks for live stock and perishables;

(13) Scale tracks for weighing cars either stationary or in motion;

(14) Bad-order tracks connecting with classification tracks for setting off cars in bad order from which they may be readily removed to the repair tracks;

(15) Wreck train tracks connecting with main tracks for housing wreck trains;

(16) Round house tracks leading to the engine houses

(17) Transfer or interchange tracks connecting the yard with the tracks of other lines for delivering and receiving cars between railroads;

(18) House tracks leading to the freight houses;

(19) Team tracks for placing and removing cars from the team yards for loading and unloading;

(20) Industry tracks leading to and for accommodating warehouses, mills, elevators, coal yards, oil tank, etc., located either adjacent to the company's tracks or on private tracks branching off from the yard lines.

5 The yard is also provided with the following appurtenances;

(1) Engine houses for light repairs;

(2) Engine dispatching facilities such as the coal station, ash-

pit, sand and water supply, wash-pit and inspection pit, tool supply station, air-brake testing plant, and stand-pipes;

(3) Track scales for weighing cars;

(4) Telephone and telegraph stations connecting with interlocking towers, engine houses, crew dispatching offices, yardmaster's office, the offices of trainmaster and train-dispatcher, and those of nearby yardmaster and station agents, for facilitating yard and train movements.

II Freight stations---A freight station is used for receiving delivering, storing, transferring, etc., freight to and from cars. It consists of the following facilities:

1 Freight houses which are usually divided into inbound- and outbound-freight houses.

(A) An inbound freight house is used for receiving the incoming freight, which is unloaded directly into the house from the tracks along the side, to be held there for the consignes who generally call for it with teams or trucks.

"It has a platform from 8 to 10 feet wide on one or both sides, which permits cars to be placed at any point opposite the house and also furnishes accommodations for the maximum number of wagons on the delivery side of the house. The house is usually posted in a systematic manner into sections numbered or lettered, and when freight is unloaded, notations are made on the freight bills showing location in order that it may be readily located."[1]

1 Dewsnup, E.R. Railway Organization and working P. 139

The freight houses handling less than carload freight usually have only one floor, while those handling carload freight which is often held for storage, have a number of stories, the freight being raised by means of elevators. A two-track-level freight house consists of a two-story building with tracks on each level. Each level may be operated as an independent unit, or the two levels may be operated one in conjunction with the other.

(F) An outbound freight house is used for forwarding shipments received from shippers' teams or wagons delivering at one side of the house. There is usually an outbound platform on the track side for convenience in longitudinal trucking; the wagon, or receiving, side is usually provided with a line of doors closely placed, so that nearly the entire side of the house is open for receipt of freight.

Inside the freight house, at one end, are the offices and a cold storage room, the remainder being taken up by the warehouse proper with scales in the center.

The necessary appurtenances of a freight house are: Transfer aprons, bridges or gangways, trucks, moveable scales, crowbars, hard-wood rollers, jackscrews, hammers, nails, saws, brooms, and barrels of water for fire prevention.[1]

In England, one platform is used for both incoming and outgoing freight and is cleared of either class of freight in about the

1 Burt, B.C. Railway Station Service Chapter 3 P.33

same time. In America, separate platforms are used and yet they are mostly cluttered with freight, especially the inbound less than car-load freight.

2 Transfer houses or platforms---" A transfer house is provided at a point where traffic is concentrated and where a necessity exists for consolidating freight into a less number of cars for movements to a certain destination, or for separating and reloading freight into a greater number of cars or into system cars for further movement to final delivery." Usually the inbound and outbound houses are located opposite each other with the tracks between the houses and a transfer platform between two sets of tracks for the purpose of shifting freight from car to car. In the case of L.C.L. freight, the inbound cars are placed on one side and the outbound cars are placed on the other side of the transfer platform.

3 Platforms---"Platforms are used for handling large and heavy shipments which can not be readily loaded directly from cars to wagons or vice versa, so arranged that cars can be placed directly at the platform". "A common type is a pocket track, with the floor of the platform at the same elevation as the floors of the cars. A derrick is provided for handling heavy freight".

4 Warehouses---Warehouses are usually provided for storing freight both inbound and outbound and relieving the terminal of the work of breaking up, assorting, repacking, and shipping out freight to country-side customers by the jobbers or railroads. Since the business of warehouse is one apart from transportation, warehouses

are not essentially a part of railway terminal facilities.

5 Elevators---"Elevators are provided for handling grains for the purpose of storage, cleaning, clipping, drying, sorting, or transferring from cars to vessels. The usual type is a system of tracks constructed over pits into which the grain is unloaded, thence being carried into bins by means of conveyers."

6 Stock yards---Stock-yards consist of stock pens for receiving and delivering live stock. The stock pens usually have chutes for loading and unloading and are sub-divided into smaller pens, holding from one to several carloads each. Feeding, watering, and weighing facilities are also provided.

III Team-delivery yards----Team-delivery yards are provided for handling carload freight which is loaded or unloaded directly from or into cars and wagons. They consist of tracks arranged in pairs with a paved driveway between each pair. They are generally furnished with cranes for heavy freight; ingress and egress are provided for teams at each end of each teamway; wagons scales located at the entrances to driveways; and platforms at the level of car floor with inclined runway for handling automobiles, harvesting machinery and other heavy objects on wheels. Team tracks may be of various classes: Coal team-tracks, lumber team-tracks, merchandise team-tracks, perishable freight team-tracks, etc.

IV *Private and Industry Sidings*----Large industrial, manufacturing, or commercial establishments provide themselves with private trackage, platforms, and handling devices connected with the railway

terminals. This eliminates the handling of freight by means of engines and the additional double handling of freight with its increasing danger of breakage, etc. It also relieves the terminal of the heavy work, delay and expenses.

V *Rail and Water Terminals*----They are located at points of interchange of traffic between rail and water transportation. They are furnished with the following facilities:

1 A cluster of general yards, into which trains are moved;

2 Lighterage piers, either open or covered, from which cars are unloaded or loaded to and from vessels;

3 Export piers, from which freight for export is unloaded and transferred from vessels, or vice versa;

4 Storage piers, in which is held, (preparatory to being loaded on vessels) such freight as flour, machinery, lumber, provisions, canned goods, etc.;

5 Inbound and outbound freight station piers, located at points which are only reached by water; cars being moved to and from them on car-floats. These are used for city delivery or receipt of freight, and team-track delivery yards are provided in connection with them;

6 Coal piers, upon which cars are run and unloaded into coal barges or vessels;

7 Grain elevators;

8 Warehouses;

9 Stock yards.

Chapter 2 Station Operation

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CHAPTER II STATION OPERATION

Preparation of Cars for Loading

Car Furnishing. For outbound movement, empty cars are ordered by the station agent by means of the switching order. The yard master places the empties on the freight house tracks, team tracks and industry tracks in accordance with the order, and upon its fulfillment the order is returned to the agent with the statement that the cars have been placed, the order then passes into the order book.

In furnishing cars, the following factors must be kept in mind: (1) selecting special equipment to fit the particular class of freight (2) supplying cars of a size or weight carrying capacity that will just accommodate the freight in order to conserve equipment, and (3) utilizing foreign cars for their homeward movement to avoid returning them empty; keeping system cars at home.

With a view to facilitate shipment, special cars have been designed and built for special classes of freight. It is essential that the employes of the station be familiar with the several classes of equipment available that they may utilize them to the fullest advantage. Freight cars can be generally classified as follows:

"Box cars" (1) The ordinary box cars are about 34-36 ft. long, 7 ft. wide and 8 ft. high, with load capacity of from 40,000 to 100,000 lbs. or over. They are closed cars having side and end housing and roof with doors in sides or sides and ends. They are used for general services, and for equipment which should be kept from weather.

(2) The ventilated box cars are similar to ordinary box cars only they are provided with ventilating devices, and are used for transporting produce or other food stuff not needing refrigeration. (3) The furniture, vehicle, and automobile cars are very large box cars with side- and end-doors or double doors. Their space capacities are very great but their load capacities are not.

Refrigerator cars. Refrigerator and vegetable cars are used for carrying commodities that need icing in transit. They are equipped with two or more bunkers or baskets and the suitable means of draining off melted ice or briny water. They have side and end sheathing, roof, and side doors, with trap doors in the roof for admitting ice and salt.

Stock cars They are used for transporting stock on hoof and are equipped with roofs, slatted sides and side doors, and single or double deck. Double deck stock cars are for shipping sheep and hogs; "palace" cars for horses. They may contain feed and water troughs; some are used in poultry trade, being fitted with netting and shelves.

Gondolas. These cars with sides and ends, open top and drop bottom, are used for coal and ore trade or general service. Some, having solid bottoms, low sides, and drop ends, are for mill trade. Hopper cars are gondolas equipped with hopper bottoms and are self-cleaning. Some are equipped with side dump hopper and others with coke racks. Twin hopper cars are equipped with two or more hopper doors instead of one.

Flat cars. They merely consist of running gears supporting top decks or floorings without sides or ends. They are used for special transportation of heavy ordinance.

Tank cars. They are used for general oil or liquid service and consist of steel tanks mounted on cranks or directly on cradles over track bolsters. Each car is equipped with one or more safety release valves, and is emptied by valves at the bottom. At the top is a dome, with or without manholes or openings thru which the tank may be filled.[1]

For designation purpose, each class of cars have assigned to it a certain group or range of numbers---say, to furniture cars numbers 6,000 to 9,999; ordinary box cars numbers 1000,000 to 99,999, etc., or one kind of cars may be designated by even numbers and another by odd. Each road issues a table of equipment showing the numbers assigned to each class of cars with their dimensions and load capacities.

It is important that the light weights of cars should be made readily accessible in all cases, and when it fails to appear on the body of the car, it should at the earliest practical moment be ascertained and stenciled. A table of estimated light weights may be found in employes' time table.

Cars of abnormal dimensions (those over 36 feet in length) are sometimes unwieldy and with their lower floor plane, dangerous and

1 *Burt, B.C. Railway Station Service P.52;*
Car Builder's Cyclopedia;
Pennsylvania Railroad Talks Vol. 1

unprofitable. Their use, therefore, must be confined entirely to times of necessity occasioned by car shortage, etc.

Since it is more expensive to handle an empty car of greater capacity than of smaller one, if a shipment can be handled in a lighter car, it should be done and the cars ordered accordingly. On the other hand, heavier cars should be used if thereby the shipment can be forwarded in fewer cars.

The economy in transportation lies in the increase in train load without corresponding increase in train length, thus reducing the cost per train mile. To realize this, cars of large capacity must be used whenever possible. Cars of large capacity have the following advantages:[1]

1 By increasing car capacity and reducing the length of trains for a given tonnage, the friction and atmospheric resistance are lessened and by bringing the moving load closer to the locomotive, it can be handled with greater ease.

2 A less number of cars and locomotives is required to move a given tonnage, saving interest and capital and car service, and lessening the empty car movement in the direction contrary to the heavy traffic movement.

3 The necessity of increasing the capacity of the main line freight yards, and shops is avoided and at the same time the cost of switching is reduced.

1 Coree, C.J. Railroad Freight Transportation P.75

4 The reduced number of trains greatly saves the wages.

Altho advantage should be taken of the foreign cars and every effort should be made to avoid returning them empty, yet the routing of foreign cars requires attention. They must be loaded to any point between the forwarding station and the original junction point inclusive; to any point on the connecting road; or to any point on or via the road to which the cars belong by any route. Care must be taken not to load them beyond the junction with the home road, nor beyond the junction at which they must diverge to go home. When cars are tacked with route cards, the direction on the route cards must be followed.

Car inspecting The cars are inspected by the car repair department before being placed by the yard crew for loading. The car inspector or the station agent, however, must inspect them and ascertain their fitness for the contemplated uses, to see that they are free from breakage, leaking roof, side, and doors, stain and odor, so as to prevent loss and damage. Special attention must be given to the selection of cars in compliance with the requirements of the Interstate Commerce Commission in the loading of high explosives, inflammables, and other dangerous articles. Unfit cars could be rendered fit by either light repairs or thorough cleaning, or otherwise rejected.

To make a car fit for loading, it may be necessary to remove all the protruding nails, spikes, screws, and bolts, to cover the floor of cars with sawdust or other material, to line the sides of cars with paper to prevent the absorption of stain or odors, and to arrange for

ventilation and refrigeration purposes and disinfection for live stock transportation.

Car spotting Placing of empties on team tracks and at industries involves no difficulty in spotting. In the freight house where the layout includes two or more tracks for the same platform, the placing involves the spotting of the cars with their doorway directly opposite so that trucking can be carried on from car to car over metal aprons spanning the space between the car doors. Long cars should be placed on the track next to platform; the short cars spotted on the other tracks to match. Each car when spotted has a spot number. "Opposite each dar door or runway on the front track, a permanent sign board is placed on the platform indicating the car classification for each car on the several tracks. In a freight house with five tracks, for instance, the sign board will be numbered 11, 21, 31, 41, 51, indicating that #11 is the first car on #1 track, #21 the first car on #2 track, etc. Opposite the second car on the first track the sign board reads 12, 22, 32, 42, 52, The first number indicates the track, the second number the car".[1]

Acceptance of Freight for Shipment[2]

Freight will be received for transportation only under the terms and specifications in the classification, tariff, bill of lading, and the special regulations of the carriers. There are goods that are

1 *Pennsylvania Railroad Talks* Vol. 1
2 For detail specification see American Railway Association Loading Rules; C.C. Kirkpatrick: Station Agents' Blue Book; B.C. Burt: *Railway Station Service*

not acceptable and goods acceptable only under certain conditions. Great care is required in receiving them.

Less than Carload shipments:

1 Unacceptable freight as provided in the Classification must be strictly rejected in order to progect the railway from loss and damage claims, such goods as clothings not in bales, musical instruments not boxed, etc.

2 The freight when tendered for shipment must be accompanied by the bill of lading and its counterpart containing shipping instruction showing legibly date, station from, consignor, consignee, destination, and county, route number, and articles to be shipped, description, weight, certificate required by State, Federal or Carriers' regulation and any other information necessary for the safe transportation and proper delivery. The shipment must be checked against the bill of lading and shipper's instruction to see if they correspond with every particular. Any exceptions to the physical conditions of the packages or any correction necessary will require a new bill of lading and a new shipping order. No alternation may be made on a bill of lading The incorrect one must be destroyed. If freight bears evidence of damage at the time of receipt, the exact amount of damage should be noted on the bill of lading.

3 Shipments must be packed and marked in accordance with the Classification requirements, or exceptions thereto, before they are accepted. Marking or stencil on packages is preferred to tags. Shipments billed "order notify" must be so marked. Improper marking

must be corrected and misleading marks removed.

4 Freight must be weighed upon accepting. The methods of weighing will be discussed in detail elsewhere.

5 Less than carload shipments of perishable commodities requiring refrigerator service should not be accepted except on days such service was being arranged for, unless shippers elect to accept responsibility for box car service and so authorize in writing on shipping directions over shippers' signatures.

6 Freight received at non-agency stations must be checked into cars by the conductor, who will make an itemized list of articles, examine the packages, and make a record of exceptions of special conditions, all of which information he should give the agent at the billing station.

Carload Shipments:

1 Carload freight is loaded in cars by the shippers. The regular large shippers especially the manufacturers of automobiles, agricultural implements, furniture, etc., are expert loaders, but the occasional shippers often make improper and careless loading. Supervision should be made before acceptance to see that the loading conforms with the Standard Rules Governing the Loading, Stowing, and Bracing of Articles as adopted by the American Railway Association.

2 Excess over the maximum loading of 10% above the marked capacity must be avoided, but full loading must be encouraged,

3 It is economical to double or triple the loading wheneber possible upon acceptance. This is done by consolidating the several shipments for the same shipper in one car of large capacity.

4 The carload freight must be checked against the bill of lading or shipping order, or in case not checked or counted, the latter should be endorsed "shipper's load and count" so as to relieve the railroad from being accountable for weight, quantity, and condition of property.

5 The freight must be weighed at the point of origin, or on the first track scale enroute.

Live stock shipments:

In accepting live stock for shipment, the following points need attention:

1 The stock cars must be clean and disinfected.

2 When loading is made by the shippers, it must be watched.

3 Stock coming from quarantine district must be inspected.

4 Special bill or live stock contract must be prepared

5 Release must be secured from the shipper for extending time limit for feeding and watering.

Perishables:

The following must be complied with in accepting perishables for shipment:

1 Special equipment must be furnished and preparation made

such as icing, ventilating, and heating. Strict attention must be given to shipper's instruction, or in the absence of such, to the published rules of the railroad regarding icing, ventilation and drainage.

2 The billing instruction must specify re-icing, prompt handling, ventilating and heating, and the point for transfer. Records must be kept of the condition of cars, of shipment, and of refrigeration service.

3 The lading must be examined to see that no damage will result and enough passage is allowed for air circulation.

4 A certificate must be required for fresh meat in interstate movement.

5 Charges for refrigeration must be collected and clearly indicated in the billing.

Explosives:

The shipment must be carried in cars carefully chosen and perfectly tight, and must be arranged and stayed according to instructions in the tariff. The nature of the shipment must be clearly indicated in the bill.

Other Considerations:

(1) Contaminative goods such as turpentine, oil, etc., must be separated from other goods. (2) Fragile goods must be receipted for according to their real nature. The bill of lading must be endorsed O.R.B., "owner's risk of breakage". (3) Goods of special value must be receipted for according to their invoice value and billed appropri-

ingly. (4) Goods to be stopped in transit have a receipt which must show the fact. (5) Goods to be delivered to shipper's order must be receipted for on the Order Bill of Lading. (6) Goods for prepay station must have all charges collected. Certain goods may be accepted only in case all charges are prepaid or guaranteed, such as advertising matters and school books, etc. (7) For freight destined to large cities and beyond, it is necessary to ascertain the precise location of the consignee and bill to the correspondent local station or to a particular station for transfer, to ascertain the terminal charges at each particular station, and to require distinct and explicit marking even including the street number.

Bill of Lading:

After the freight had been checked against the bill of lading and accepted, the bill of lading must be signed by the shipper and the station agent; the "original" and the "triplicate" (or memorandum), portions of it, being delivered to the shipper, while the "duplicate" (or shipping order) is retained by the agent. Shipping orders must be filed as an important part of the station record since upon them is founded the waybills or documents accompanying the shipment to destination.

Weighing of Freight

Freight must not be accepted for shipment unless the weights are ascertained. Shipments brought to station too late for weighing should be refused or held over for the following trains. When freight can not be weighed for special reasons, notation must be made on the bill-

ing to the agent at destination. Weighing adds to the cost of handling and tends to delay shipment, but is should, nevertheless, be done. Negligence in this respect may easily bring loss of revenue to the railroads. Again, freight, especially less-than-carload shipments, must be weighed at the point of origin for the following reasons:[1]

1 "It affords a substantial basis on which to determine the merit of claim for alleged subsequent loss.

2 "It insures a more detail check as to the number and condition of the packages.

3 "It precludes the possibility of failure to weigh promptly packages subject to natural shrinkage.

4 "It provides actual weight for billing and eliminates correction on weight variation.

5 "It permits of more expeditious delivery at destination.

6 "It provides for more prompt and effective supervision.

7 "It establishes the extent of liability of carrier to enable quick disposal of claims".

Weights are generally ascertained by the following methods:[2]

1 *Actual Weights* which are arrived at by actually weighing carload freight by track scales and the less than carload freight by freight house scales. The weighing of less than carload freiight

1 Droege, J.A. Freight Terminals and Trains P.217

2 Kirkpatrick, O.B. Station Agents' Blue Book;
Burt, B.C. Railway Station Service P.169

can be facilitated by adjusting all the hand-trucks by adding leaden weights to them, thereby bringing them up to a predeterminable uniform weight. The platform scales are then adjusted to balance with the empty trucks on the scales.

2 *Agreed or Shipper's Weights.* With a view to expedite the handling at station, sometimes the actual weighing process is eliminated by an agreement made between carriers and shippers that the shippers' weight will be accepted. But the shippers' weight must be fully certified. Upon acceptance, it is important to ascertain whether the weights are gross or net.

3 *Tariff Weights.* Such weights as are specifically provided by the Classification, Exceptions thereto, Tariffs, or Rules of Carriers, take precedence over weights furnished by shippers under their industry scales or weight agreement.

4 *Estimated Weights.* The Classification or Tariffs provides that certain articles must be or may be accepted for shipment at an estimated or arbitrary weight as provided in such tariffs. The reasons are: (1) that the actual weight for some shipments can not be ascertained and (2) that sometimes a carload shipment moves between points at which no track scales are located or a less than carload shipment moves to a non-agency station. Altho these weights can not be actual, yet they must be well grounded in the nature of the shipment upon which such weights are properly applicable; guess-work should not be permitted. Again, it is an undesirable practice to bill a shipment at an estimated weight at destination.

5 *Minimum weights.* The minimum weights as established in the Classification or the Tariffs, are the lowest weights at which certain specific classes of shipments may be charged for. They protect the carriers against the misapplication of their equipment by underloading, while the maximum weights (10% above the loading capacity) prevent the abuse of equipment by overloading.

6 *Certified Weights.* They are weights which are accompanied by an affidavit or by formal and explicitly signed affirmation of shipper or of some weigh-master as to their correctness. In claims, they may sometimes take precedence over carriers' track scale weight.

7 *Invoice Weights.* They are the weights shown on the shippers' bill of sale for goods bought or sold, and have about the same value as certified weights.

Trucking Freight to Cars for Loading

Freight may be classified according to quantity into C.L.(carload) and L.C.L.(less-than-carload) freight. The C.L. freight is loaded by the consignors and unloaded by the consignee, the cars being delivered for loading and unloading at the various team-tracks or industry tracks as the case may require. The L.C.L. freight is delivered by the consignors to the freight house of the carrier and is delivered by the carrier to the consignees at the freight house, the handling from freight house to cars and from cars to freight house being performed by the carrier.

After the L.C.L. freight has been accepted for shipment, the Route Clerk marks the loading classification number on the shipping

order, and the Receiving Clerk places it on a file with a number corresponding to the number of the doorway where the shipment is unloaded. The truckers or a gang of truckers will then remove the shipping order from any file and commence loading the trucks for the movement to the cars. As the cars for different destinations are set or spotted at specific points on the tracks, the truckers become accustomed to their locations and make delivery with little error. The teamsters delivering the shipments are required to drive to the doors of the freight house nearest the proper cars for outbound freight, thus reducing trucking to a minimum.

The economy in trucking lies in getting the freight from the receiving point to the designated car with the minimum time, effort and expenditure; hence the following requirements:[1]

1 The trucking surface must be smooth and free from obstruction.

2 The shortest and the most direct route must be traversed.

3 The highest safe speed must be pursued.

4 Rehandling must be eliminated or reduced.

5. Full loading must be provided for each carrying unit.

Some roads allow teamsters delivering small lot package freight direct to cars placed on team-tracks to save labor in loading, but it is not a good practice because the freight cannot be weighed.

Under ideal conditions, the freight accepted for shipment should never touch the floor of the freight house, but should be

1 Droege, J. A. Freight Terminals and Trains Chapter 25

loaded directly from the wagons onto the platform trucks, eliminating the process of rehandling from the floor. Every extra handling evidently means added expense and danger of damage. The weighing can be done by moving the loaded truck to the scale, all trucks are adjusted to bear the same weight, which is deducted from the gross weight.

There are two systems of trucking: the gang system and the drop truck system.[1]

1 Under the gang system, a checker (or a Shipping Clerk), a loader, and three or four truckers from a gang. Each trucker has a two-wheeled hand-truck, and pushes it light or loaded from the receiving door to the car and back again stopping to load and unload at either end of the haul, the amount of light mileage equals the loaded mileage and at least one or two extra handlings are required. The freight goes from the wagon to the floor; from the floor to the truck and usually from the truck to the floor again at the car door only to be rehandled by the stowmen in loading it in the car. It involves at least two distinct operations, as well as much lost motion through the necessity of pushing the freight back to clear the doorways, increasing the possibility of damage to freight and the splitting of shipments. Again, the shipping orders can not be sent to the billing department until after the final check by the tallymen, thus incurring delay.

1 Droege, J. A. Freight Terminals and Trains P. 355

2 Under the drop-truck system, the empty trucks stand at the receiving doors and are loaded by the Check Clerk and Callers directly from the wagons, keeping the freight, except packages too large and bulky, entirely off the freight house floor and on wheels. The receiver or the tallyman counts the number of packages, compares the marking and then checks the freight with the block number of the outbound car; the bill of lading is signed and returned to the teamster, while the shipping order, except in rush hours, passes immediately to the Billing Department. Loaded trucks after the completion of the tallyman's check are pushed away from the doorways, thus keeping the doorway clear. The trucker pushes the load to the car door and leaves it there, returning empty handed to the nearest receiving door for another loaded truck. The stowman unloads the freight from the truck directly into the car, and the empty truck moves across the platform to the receiving door. With the exception of the occasional redistribution of empty trucks to take up the inequalities in movements along the platform, there is no light truck mileage, and the trucker delivers the maximum amount of freight to the car with the minimum number of stops.

Not only the economy in trucking but also the correctness in trucking must be emphasized. Moving freight to and loading it in wrong cars has serious consequences resulting in additional effort and expenditure. There are several way of checking errors in trucking.[1]

1 Byers, M. L. Economics of Railway Operations, P 520
Droege, J. A. Freight Terminals and Train, P 403

1 Verbal system At the point where the freight is received and weighed, the tallyman instructs the truckman as to the number of the car in which the freight is to be loaded. The trucker on his return, states to the tallyman the number of the car in which he has placed the freight. The tallyman then checks off the freight on the waybill as having been properly loaded. The stowman examines the marking on the packages and stows them into the proper cars. This system solely relies on the attention and memory of the trucker.

2 Direct ballot system Each car is supplied with a small box. Each tallyman at the scale possesses pasteboard tickets numbered to correspond with the house number of the cars to be loaded. The tallyman gives the trucker one of these tickets to indicate into which car the freight is to be loaded. The trucker, on placing the freight in the car, deposits the ticket in the letter box. Should it be found that the ticket number does not correspond with the car number, the freight is wrongly loaded and it requires considerable work to rectify the error.

3 Return ballot system. Ticketa are placed in the box in each car before the loading of the car is commenced. The trucker, upon loading his freight into the car, returns to the tallyman, bringing with him a ticket taken from the box in the car, the number of the ticket enabling the tallyman to see into what car the

freight has been loaded so that an error can be rectified at once.

4 Veri-check system It is similar to return-ballot system, except that a veri-check or ticket is issued to the trucker by the tallyman with each load, the ticket showing the block number to which the freight is to be trucked, the number of piers, the checker's name and number, and the trucker's number. Upon arrival at the car, after the freight has been dropped from truck, the trucker stamps the ticket with the number of the car (stamp pads and stamps are located in each car, and the number on the stamp is the block number of the car), which should agree with the number inserted by the tallyman. Upon return to the tallyman, the latter notes whether the numbers agree. If they differ, wrong loading is apparent, and they can be corrected.

5 Mockridge system A tallyman stays in a box near the scale operating a machine which produces the ticket and stamps on it the house car number and also with a consecutive number which serves to identify the package on both the ticket and the invoice. The trucker takes the ticket with the freight to the car, where the ticket is examined and punched by the stevedore, or stowman, before it is put in the ticket box in the car. This system has its disadvantanges in that the installation of the machine is expensive; the tallyman is put into a box only operating a machine, and much time is lost in examining and punching the tickets by the stevedore.

The shipping orders are collected at short intervals (10 or 15 minutes), the number of pieces and the car numbers checked against

the ballot or ticket, errors if any, being corrected immediately, and the shipping orders being sent to the Waybill and Rates Department.

In some countries, like China, a problem exists in training illiterate truckers. A vivid description has been given by J.A. Droege of a unique method of instructing illiterate truckers successively employed on the Panama Railroad.

"The truckers are of all nationalities. Ninety per cent. of them can not read nor write but none are color-blind. At each terminal the steamship lines and railroad have checkers. A negro works with them calling freight, and, when traffic does not run heavy, he also marks it. He has a tiny tray, a brush, holders and a number of small pots containing paints of different colors. A truck coming containing a box for a certain destination, Callae, for instance, and a stroke of yellow and one of green are applied. The trucker proceeds to the car on which a placard is hung with corresponding colors. A package going into the wrong car will show whether the painter or car stower made the error. At Balboa, crayons are being tried instead of oil paints." [1]

Car Loading

Car loading is an important factor in freight transportation. On it hinge the carriers' revenue, the safety in carriage, and the time in movement. Every effort should be taken to guard against underloading, overloading, and improper stowing so as to realize the full utilization of equipment, to avoid break-down on road with

1 Droege, J.A. Freight Terminals and Trains P.407

resultant congestion and delay, and to minimize claims. Loading, however, is very difficult to check and control. Unlike train-load which is apparent on train-sheet, conditions in car loading, especially in box cars are hard to detect. This problem requires great vigilance and keen judgment.

C.L.Loading. The loading of carload freight is entirely in the hands of the shippers, and the railroads can exercise little control. It comes to the railroad stowed and riding under a single waybill. Nevertheless, inspection must be made to see if the loading instructions have been observed. For instance, the lading must be securely blocked or braced; in a closed car, the lading must be kept away from the car doors; the weight of the lading must be approximately the same on each side of the car; etc. Again, the minimum and maximum loading requirements must be strictly enforced.

L.C.L.Loading. The L.C.L.,or package, freight loading constitutes one of the most difficult problems on the average railroad. Its tonnage is only 4.5% of the total tonnage yet it requires [illegible] of the country's freight cars.[1] It arrives at the freight house in all sizes, shapes, and conditions, consigned to different individuals in different localities. The loading of this heterogeneous mass constitutes a task out of all proportion to the importance of the revenue received for the traffic; and it is only by the strictest attention to every detail of the work that it can be handled with satisfaction.

1 Corre, C.J. Railroad Freight Transportation P.489

to the patrons and with profit to the railroads. In loading L.C.L. freight, the following points must be constantly kept in mind:

1 To secure the minimum time in transit.

2 To minimize the number of transfer en route.

3 To practice the heaviest possible loading at freight houses and transfer stations consistent with dispatch in movement of freight and avoidance of damage.

4 To utilize all suitable cars for loading in the direction of light movement, keeping down the empty car mileage.

5 To stow the freight securely and easily for unloading.

The volume of traffic received for transportation at the terminal must be constantly analyzed and studied with a view to bring about the following arrangements:

1 Loading cars to their final destination. This eliminates delay and expenses in rehandling, and in consolidating small shipments into full carload at transfer, resulting in quick service; conserves man power by avoiding transfer en route, and car supply by heavy loading; and reduces danger of damage in transfer.

2 Loading freight for a number of stations, adjacent to each other so that the freight may be delivered over a particular route in station order.

3 Loading freight for the most appropriate transfer station for rehandling. In case the tonnage is not sufficient for direct loading and the shipments are bound for diversified routes, it is necessary to load the freight to the transfer nearest the final

destination from which direct loading is possible.

Since transfers mean (1) added expense in handling, checking, billing and switching, (2) increased danger in loss and damage, and (3) delay to car movement, they should be avoided as much as possible. The point for transfer must be properly designated so as to justify the rehandling, that is the consolidating of freight from converging lines into a solid car going straight to destination and the unloading of freight into local or peddler cars to be distributed over the various way freight runs and for other transfer stations.

The location of the transfer station is based on the study of the special reports of freight forwarded from each station for a period of sufficient length to give a reasonably accurate average condition. Where it is found that sufficient freight is loaded at a given point for a group of other points, arrangements are then made for assigning a car for that particular loading. In some cases a car is made every other day, or every third day, and freight held over the intermediate days.

Full Loading. In handling the system cars in the predominating traffic direction, it is imperative that cars should be loaded to their full capacities and worked to necessary transfer points to avoid as far as possible any movement without full tonnage so as to reduce the number of loaded cars and the corresponding empty mileage. It is only in the handling of loaded cars that earnings are made, while the expense of handling the empties, all things considered, [illegible]

practically as high as that of handling the loaded. Excessive car supply loaded in a wasteful manner had even less satisfactory result than insufficient car supply but efficiently and economically loaded. To load a car half filled means to increase the amount of dead load in proportion to the amount of revenue freight hauled and consequently increases the cost per ton mile of revenue freight.

Full loading of cars, however, may not always be possible; the following factors often stand in the way:

1 "At some stations, a full carload of freight for a single point is seldom received, and the competition is keen enough to make it impossible to hold the freight long enough to accumulate a carload.

2 "Commodities such as furniture, feathers, etc., weigh but little as compared with the space they occupy.

3 "After the car is two-third full, increased effort is required to complete the loading; therefore, unless the matter is given careful attention, the tendency is to start loading a second car, leaving the first with but a partial load.[1]

While maximum loading is the goal, it is not wise to seek it blindly without giving due consideration to other features. In the direction of light traffic, cars may be loaded light, and cars forwarded to station with comparatively light load to save time and reduce handling. Time is an important element, and there is naturally keen competition for traffic in the direction in which the light cars move. Foreign cars when not in demand, may be started homeward with a light load. In determing how it shall be held for cumulative load-

1 Byers, M.C. Economics of Railway Operation P.530

ing, it is necessary to figure the amount of per diem charges involved the distance the commodities and the cars move, the supply of cars at hand and the demand therefor, and the train service.

Instructions requiring the freight to be loaded to certain large stations or to certain sub-stations or piers in controlled territory with a specified minimum per car, should be issued to all concerned, including agents at stations and transfer points, and local freight solicitors. When the minimum load is not available, the instructions should specify the transfer points to which the freight should be sent to be consolidated or state how long the freight may be held at originating point to secure the required minimum for a straight car for any destination. It is also necessary to indicate the train on which these cars are to be forwarded, bearing in mind the Fast, Slow and Local freight schedules so that close connection will be made and terminal delays avoided.[1]

In order to increase the average load and to secure the instructions being complied with, the following measures may be taken: (a) requiring reports from agents of cars received without a full load giving the point at which the cars were loaded and then calling the matter to the attention of the forwarding agent; (b) requiring reports of the average loading and nature of commodities placed in each car at each station, which are to be studied for improvement; (c) requiring the inspectors to constantly engage in observing the cars loaded and

1 Droege, J. A. Freight Terminals and Trains P. 137

received for unloading at different stations and calling attention to the points at which loading is not receiving proper consideration.

The setting of minimum weight is also an aid to heavier loading. On the Pennsylvania Railroad, certain minimums are used as the general basis for the establishment of carload weights, for instance:

(a) 10,000 lbs. or more for destination within a radius of 150 miles.

(b) 15,000 lbs. or more for destination within a radius of 250 miles.

(c) 20,000 lbs. or more for any destination.[1]

Way-freight or local freight loading. Freight for the smaller stations, or way stations between terminals, is seldom received in sufficient quantity to permit of its being placed in a separate car. To avoid delay and expense, it is handled by the local trains in peddler cars loaded and unloaded by the local train crews at the different stations en route.

The way freight must be carefully checked against the billing prior to the arrival of the train, and put on trucks or separated from other freight and placed in the usual place for loading. Upon the arrival of the train, the waybill must be delivered to the conductor who designates into what car they shall be loaded, and checks the loading as being performed by the train crew.

Considerable saving of time of the local freight trains can be brought about by loading the freight in station order; freight for the last station is put in the end of the car, and that of the first

1 Pennsylvania Railroad Talks Vol. 1 #3

station at the doors of the cars, so that it can be unloaded without disturbing the other freight. By experience, it can easily be told about what proportion of the car to allot to each station, and by loading the car on one side, leaving a passage way along its entire length, when freight enters the car, it can be placed in the proper order without much additional labor.

A second method is to set aside one empty car in the train for all freight picked up for a given district. If the district is beyond the terminal of the local freight train, the car is set in at the terminal freight house and the loading finished for the freight collected at that point.

A third plan is to locate transfer stations at certain junction points and to haul to them unassorted whole carload of freight destined to various points beyond these junction points. The freight is unloaded on the transfer platform, assorted and reloaded for each individual point or district beyond. This process usually affords quick releases of cars.

With a view toward increasing carload and reducing car miles the number of peddler cars must be kept to the minimum. The peddler cars of every distributing point should be carefully watched to see that two cars light loaded are not being sent over the route when one, systematically handled, would serve the purpose fully as well. When the loading to certain points is usually light, arrangements can generally be made with the consignors and consignees for service every second or third day, eliminating many light loaded cars.

Competent revision of peddler car schedules will generally result in the reduction of the number of cars required in the service.

Trap or Ferry Car Loading. There are large quantities of L.C.L business loaded by shippers at their plants into what are known as Trap or Ferry cars. Such cars contain several L.C.L. shipments destined to different places which are to be distributed at the railroad terminal at the point of origin into "straight" carloads which are to be forwarded to their respective destinations. They are loaded indiscriminately and moved to the transfer stations where the shipments are unloaded, sorted and reloaded. In order to minimize the reloading loading guides or special instructions should be issued to enable the shippers readily to ascertain the proper transfer points to which the shipments should be loaded. The guide generally contains an alphabetic list of stations, and the station numbers are grouped under the proper transfer points. Thus, the shippers can group their shipments according to their transfer points and so regulate their loading that cars aan be so made as to reduce the handling at intermediate points. This system, when properly carried out will save time, reduce damage, and prevent improper loading.

Loading at Transfers. At each transfer point, a loading program must be worked out to dovetail into the large general plan of the road as a whole. Detailed programs and instructions must be made out and issaed to the smaller stations and the conductors of local freight trains.

The mannee of loading at the transfer station has much effect

upon the other stations. Any hurried or improper loading at the transfer point, aiming at a few cents saving at that point, often incurs heavy loss and trouble at the subsequent stations, involving the rehandling or the return of freight to the transfer, the reloading or holding for another car, the tracing of misplaced freight, the damage resulting from exposure or additional handling at points where facilities provided are meager, and the occupation of the main track to the exasperation of the train dispatcher and the crew of the train.

Merchandise or package cars. At the present day, most of the roads have done much to avoid reloading L.C.L. shipments at junction points by operating so called merchandise or package cars. The L.C.L. freight is loaded whenever possible into "straight" cars to be shipped directly to the destination, and in case of interline shipment, it is arranged that such cars shall be interchanged without transfer of lading at junction points. Again, the package cars may be operate regularly between certain stations, local or interline, when a specified minimum weight of L.C.L. freight is offered. This arrangement expedites the haul and avoids rehandling with adherent danger of damage.

Loading efficiency. Efficiency in loading requires that the loading be completed in due time to expedite the car movement. To do this, it is necessary that the outbound freight houses should be closed not later than 5 p.m. in order to allow the unloading of all teams arriving earlier and the loading up of all freight received.

This would enable the pulls from the houses to go to the distributing yards promptly at 6 p.m. to be made up into trains, which could leave without delay, and thus arrive at their destination at the earliest possible moment. If the yards are kept open later than 5 p.m. for the receiving of teams, either the pulls from the houses and consequently the departure of the trains are delayed, or the freight is allowed to be piled on the freight house floor, causing the additional expense of rehandling as well as risks of loss and damage.

Arrangement should be made with the shippers to send their packages to the freight houses more uniformly, at all hours of the day, instead of concentrating them in the afternoon, and to load their wagons in such a way that each shipment, whether consisting of one or of a dozen articles can be unloaded from the wagons to the freight house truck without any delay in sorting out the articles, each article being plainly marked with full names and destination and the accompanying shipping ticket showing its actual weight. The majority of shippers send their goods to the freight houses so loaded on the wagon that it is impossible to sort the different packages for any one shipment, It often requires the unloading of the whole load on the freight house floor in order to locate the particular article of the shipment. This evidently means annoyance, delay and expense.[1]

Stowing Freight in Cars.

Stowing plays an important part in freight station operation.

1 Dewsnup, E.R. Railway Organization and Working P.71

It insures the safe loading of freight, preventing as much damage as possible and checks the freight against the bills with a view to discover any error in the work of checkers or callers at the receiving doors, any loss of damage to goods while in the house, or any error of truckers in delivering shipments to the wrong cars.

With the use of large locomotives handling long and heavy trains the jolt and jars can hardly be avoided. The universal use of automatic couplers also increases the liability of damage to freight. Hence the stowing and blocking of shipments should receive all the [illegible] attention.

Freight should be stowed, lengthwise of cars, on the surface offering greatest resistance to shock in transit. Exceptions may be made when freight can be stowed to better advantage when each piece will hold another in position. Freight liable to shift should be securely blocked.

Freight should be so stowed as to evenly distribute the weight in car, and piled to a uniform height so far as the articles will permit, in such a way as to prevent packages falling and damaging other freight.

Freight subject to damage by water should be stowed as far from doorway as possible.

Freight liable to freeze should be stowed away from doorway, sides and ends of cars, closely surrounded with other freight and raised at least two inches above the floor.

In loading way cars for distribution freight must be loaded in station order

Packages should be stowed with addresses up, except packages marked "this side up", must be so stowed.

Heavy packages should be loaded on the floor with light packages on top.

Commodities in bails, tubs, buckets, and friction-top cans should be loaded top-up to prevent leakage.

Hooks must not be used in handling freight in sacks (cotton excepted), fibre containers, or other containers liable to be damaged thereby.

Commodities containing contaminating odors must not be loaded near freight that is liable to absorb such odors, nor should they be loaded in refrigerator cars."[1]

Merchandise should not be loaded in same end of car with automobile, hearses, or highly polished vehicles. The rest of freight should be braced.

Casks of china, crockery, glassware, etc., should always be loaded on ends address up and must not be rolled.

Ice or commodities packed in ice or brine must be stowed near door, car floor around packages cleated and space within cleats filled with dry sand , saw dust, etc., so arranged as to allow a large leakage to pass under door.

Sack goods must not be loaded on the car floor until the car floor has been thoroughly cleaned and covered with clean, dry paper,

1 Code of L.C.L. Rules, American Railway Association

or other pollutating materials. The greatest care must be exercised in stowing sacked goods of every description to see that each shipment is not kept in contact with iron articles that would tear the sacks.

Absorbent goods must not be loaded in cars previously used for freight emitting offensive or destructive odors, or at car doors where they are liable to damage by water.[1]

Freight house men must learn to so load large cars with package freight as to prevent shifting. After part of such a car is unloaded the remainder must be arranged to avoid shifting.

"Besides the mere exertion of strength in stowing, it requires the exercise of ingenuity and skill in the management of tools and appliances and in taking advantage of the natural forces. A good judgment is requisite.

" The stower should know beforehand, in a general way, what disposition is to be made of the freight in the car. To this end the car is partitioned mentally or by designing in chalk in separate spaces for distinct shipments or group of shipments, as required by the different destinations of the shipments, the spaces being arranged according to the order in which the shipments must be unloaded from the cars in its progress along the line."[2]

Exceptionally heavy pieces like machinery, are left to be handled by a special gang. Similarly explosives, inflammables, and acid

1 Gilmore: Terminal Freight Agency, Pennsylvania Railroad Talks
2 Pratt, E.J. Railway Station Service P.117

shipments are given special attention, one car being assigned to this work, and to placarding the cars.

Classification of Freight Service

Freight may be shipped in different ways. It is necessary to afford different freight with the proper service in accordance with nature of the freight and expediency.

1 Expedited Freight Service. Certain classes of freight such as perishables, live stock, and other commodities requiring quick delivery are given expedited service and shipped in so called preference or fast freight trains running on scheduled time and high speed with special billing and carding.

2 Slow Freight Service. Slow freight consists mostly of raw materials the usual requirement on the part of the consignee being the receipt of a certain quantities of this class of freight at given intervals of time rather than the receipt of any particular car. They run at slow speed, in full load, and generally at the time when enough shipments warrant the movement.

3 Local Freight Service. Freight moving from the point of origin to the first terminal en route or from the last terminal en route to the point of destination are shipped in local trains which move on schedule time and stop at all points where are to be received or delivered.

4 Shipping Day Service. With a view toward economizing the utilization of cars and toward reducing the congestion at terminal

transfer stations, L.C.L. freight may be held at the point of origin for a short period, allowing it to concentrate automatically into car-load each for a single destination. Large cities having freight stations are to have particular stations designated at which freight should be exclusively received for specified destinations. Shippers may route freight over any line, and may deliver freight to carriers on any business day but the carriers can fix the schedule for sailing day. This system, according to J.C.Gilmore of the Pennsylvania Railroad, "saves about 40% in cars for handling L.C.L.business and also affords a next day delivery within 130 miles from shipping point."[1]

Routing

On large systems, several routes can be applied for handling freight between two points. The choice of these routes depends upon the relative distances, relative grades, relative traffic densities, relative facilities such as second tracks, passing tracks, and other items affecting the cost of movement, and the direction of light movement. The following points must be kept in mind in routing freight:[2]

1 "Hauling cars by such a route as will give the fastest and cheapest movement.

2 "Avoiding congested points.

3 "Utilizing light power.

4 "Reducing the difficulties in the execution of movement.

1 Pennsylvania Railroad Talks Vol.1 #2
2 Byers, M.L. Economics of Railway Operation P.[illegible]

5 Consulting the train schedule and considering the connections so as to avoid delays at junction points".

The shippers have the right to designate in writing in all cases where thru routes are established, by which of the thru routes such shipment shall be transported to destination. Where there is more than one thru route in effect, and no routing is requested, the shipment must be routed by the cheapest practical route.

Waybilling

After the shipment is trucked to the outbound car, the shipping order is sent to the Rate and Waybill Department. The rate clerk calculates the rate for such item, marks the total on the shipping order, and delivers the latter to the Waybill Clerk who makes out a waybill thereof.

The waybill is a transcript of the shipping order. All information necessary for the transportation of the shipment must be reproduced on it. It is the authority for the transportation of freight showing service to be performed and charges to be assessed, and is the form used in accounting for freight revenue.

There are different kinds of waybills employed for the various freight services. They may be classified as follows:[2]

1 Small, medium size, and "blanket" waybills. The former two

1 Butt, C.C. Railway Station Service P.137

need no explanation. The Blanket waybill is used when a large shipment or a shipment containing many articles to be specified is to be billed; and when there are a considerable number of different shipments having the same destination, it lessens the labor of abstracting bills by reducing their number.

2 Colored waybills. Certain expedited freight such as live stock, perishables, and time freight bear colored bills (red for perishables and green for time freight, etc.) so as to attract attention. The ordinary or slow freight has white waybill.

3 Local waybills for local or way freight.

4 Thru way bills for interline shipments.

5 Collection waybills. They are used not for billing freight but for billing out charges to be collected.

6 Prepaid Only waybills. They are used to bill out charges that are to be paid out or are to be applied on a billing that has already preceded.

7 Revenue waybills. They are regular billings of whatever sort.

8 Memorandum waybills. They are improvised but not authorized to carry a shipment to its destination, without reference to any charges.

9 Stray waybills. They are used to cover the transportation of L.C.L. freight checking over without revenue billing. They are similar to memorandum waybills except more authoritative.

10 Card waybills. They are used in case the regular billing for a shipment, usually a carload, cannot be prepared in time to

accompany the shipment which must be forwarded without delay. They contain a brief notation about the shipments. While theoretically, regular billing should accompany every shipment, practically it is convenient, and even necessary to send with many shipments merely card waybills, allowing the regular waybills to follow by mail, especially at large stations where freight reaches the station late and regular billing can not be prepared.

11 Other Waybills, such as Switching Waybills, Company Material Waybills, and Freight Train Baggage Waybills, etc.

One copy of the waybill is kept on file by the station agent at the shipping point, and another is sent to the auditor of freight accounts. The "original" either accompanies the shipment or is mailed to the agent of the point of destination. It is necessary that the regular waybill ot otherwise card- or memorandum- waybill should accompany the shipment. A car arriving at the destination without ~~without~~ waybills will cause much complaints, claims, for loss and damage, theft, delays, and additional clerical work.

If possible, a box may be installed inside each car, and a triplicate copy of the waybill can be made out and deposited in the box so that it can be always at hand with the shipment.

The painful consequence of mistakes in waybilling needs no mention. Any inaccuracy might lead to misdelivery, delay demurrage, and additional expenditure. The following common errors must be strictly guarded against: (1) errors in names of consignees; (2)

omission of destination; (3) omission of car numbers; (4) errors in names of articles billed; (5) omission of connecting line waybill reference; (6) errors in classification of rates; (7) omission of advanced charges; (8) omission of notification as to the condition of shipment and of instruction of shippers as to refrigeration, ventilation, etc. In case errors are discovered in the waybill, a "waybill correction notice" must be sent out which states how the waybill reads and how it should read.

At the time for the movement of the cars from the freight house the waybills are delivered to the yardmaster to accompany the cars completing the outbound transaction from the forwarding point.

Carding or Chalking Cars

After the cars are loaded, the yard-clerk goes along them with a switch list to mark the contents and destination of each car for the purpose of showing the railroad employes the direction for the operation of the cars. The marking may be done either by chalk or by the tacking of cards. The former process, being simple, saves time labor and expense, but has the danger of being rubbed out or washed off. The cards are printed in different colors and bear indications as to direction and districts. In addition, they show car number, date, origin, destination, and contents. Those for transfer cars are marked "transfer" and other necessary references, and those for inbound cars contain the date of arrival, name of transfer station, and of consignees.

Sealing Cars

Every car except those carrying live-stock, coal, timber, etc., to be moved, must have its doors fastened and protected against being unlawfully opened by means of seals, which serve as a record of movement of freight. They are strips of tin, self-fastening, with an impression consisting of letters, or letters and figures stamped or painted on them. Each station is represented by a peculiar impression. Whenever the record becomes discontinuous, then the seal is known to have been broken, and the car to which it is attached is presumed to have been broken; investigation may reveal just where, when, by whom, and why the car was opened, and so locate responsibility.

Seals and seal presses must be kept under lock and key when not in use. Cars containing bonded goods must be secured by U.S. Customs Seals to be applied by the Customs Officials. They must not be opened by any one other than Custom Officials.

Seal broken or imperfect must be immediately reported for locating the responsibility, and replaced to protect further movement. Cars will be considered imperfectly sealed under the following conditions: (1) absence of seal; (2) seals imperfectly applied; (3) broken seals; (4) indistinct impression; (5) blank seals; (6) seals on insecure car door fastening; (7) wrong seals.

Opening of cars in error must be regarded as an interruption in the continuous record unless an affidavit as to the manner of the opening is made by the employee opening the cars in error.[1]

1 For detailed requirements see Sealing Rules of [illegible].

Forwarding Loaded Cars

Cars loaded and sealed in the freight house tracks are pulled by the yard engine to the classification yard where they are made up into trains. Car numbers and initials are checked and reported by the number taker to the train clerk who then checks up the list of cars and furnishes a waybill for each loaded car. The conductor of the train also takes a list of the numbers of all the cars in his train, which list is checked with that of the number taker, and if they agree and correspond to the numbers on the waybills, he receives the waybills for the cars and starts the train. The list made up by the number taker is also delivered to the Car Record Clerk who records the numbers of cars, date of leaving, train number and destination.

Not infrequently loaded cars are not forwarded in time or are detained in movement. The common causes attributable to the delay are as follows:[1]

1 "Yardmasters are not promptly notified by the agent after the car is loaded and ready for movement.

2 "Failure to properly inspect empty cars before loading results in the necessity for correcting defects while the car is under load, thus delaying both car and lading.

3 "Waybills are not properly prepared and consequently the car not be moved towards the destination.

4 "The car is lost sight of in the yard by being set off on out-of-the-way siding or back of the other cars which is not [illegible]

immediate movement.

5 "Cars are set off en-route by mistake or on account of defects and not reported; as a consequence, no one is given order to pick them up and forward them to the destination.

6 "Cars loaded at outlying sidings where there is no agent, and are not reported.

7 "The non-receipt of the regular waybill by the agents at the transfers or at the destination."[1]

The prevention of delays in forwarding and disposing of cars under load can be accomplished in several ways.

1 Requiring conductors to give daily reports of cars on the blind siding to the Chief Train Dispatcher and the Superintendent of Car Service.

2 Requiring the station agent to report daily to the Division Superintendent and yardmaster concerning cars on hand by daily canvass of the entire yard.

3 Checking up car records constantly.

4 Giving special attention to loading and waybilling.

Unloading and Storing Inbound Freight

When inbound cars are placed for unloading, a record of the seals and other door fastenings must be taken. Carload freight, where C.L. rate is applied, must be unloaded by the owner or consignee

1 Byers, M.L. Economics of Railway Operation p. [illegible]
2 Byers, M.L. Economics of Railway Operation p. [illegible]

unless otherwise provided in the classification or tariff. The railroad is mainly concerned with the unloading of L.C.L.freight.

Upon the receipt of the waybills (which generally accompany the car, but are sometimes sent by mail), they must be stamped with the date on which they are received.

The car should be opened only by the station agent or his authorized representative such as a warehouse foreman or a check clerk. The condition of the lading and the interior of car must be examined and reported.

Freight must be checked when removed from cars. Checking may be done in two ways.[1]

1 Check-on-the-waybill system. A tallyman is placed in each car which is being unloaded. He is furnished with the waybills for the cars. The caller picks up the freight, puts it on the truck, and calls off all the marks on the package, which the tallyman checks against the entry on the waybill noting the exception thereon. This system saves time and energy, but has the danger in that the tallyman might mark off items for which the freight is not at hand or check off items mechanically before the freight is actually unloaded. In case the freight comes ahead of the waybill, the checking may be made on the freight bill; and the waybill may be revised upon its arrival.

2 Blind tally system. The tallyman is provided with a sepa-

1 Kirkpatrick, A. P. Station Agents Handbook p. [illegible]

lined inbound tally-book in which he enters the marks of all freight unloaded. The consignees' names are entered in alphabetical order and the articles are listed thereunder. This record is later compared with the waybills by the agent's clerical force and discrepancies noted. This method entails considerable work and is quite expensive. However, it insures a much closer check.

All freight unloaded, except that which the waybills show has been weighed at the original station and that which is protected by the tariff estimated weights, must be weighed over the freight house scales and checked against the waybills. Of course, the bills bearing Weighing Association stamps need not be corrected.

The name of stations, car number, and date of unloading must be stamped or marked on each package unloaded.

The stevedore must examine the freight upon unloading. If it is in bad condition, he must report to the foreman who shall decide whether it is to be sent to cooper shop for repair. The cooper, before repairing, should investigate the contents of the package; if damage is found, he should mark it and leave it alone for the freight agent to settle the case.

There is danger in unloading heavy and bulky freight without proper assistance. Explosives, inflammables, acid and other extraordinary shipments must be handled by special gangs. It might be better to delay a little the delivery of the freight than to be too much in haste to get rid of it. On the other hand, to allow long

freight [illegible] too long, [illegible] damage, pilferage [illegible] stolen must also be avoided.

After unloading a car, the seals and side cards should be removed; failure to do so often causes error and confusion, when the car is again loaded or started empty.

In trucking the freight to the freight shed, care must be taken not to overload the truck, since packages are very liable to fall off and be damaged.

In stowing the freight in the freight shed for temporary storage it should be properly piled so as to utilize all the space available, and a passage must be allowed for trucks.

The inbound freight house is generally divided into two parts, one for the placing of transfer to connecting line freight and the other for city freight. The latter is sectionalized into subdivisions for each consignee so as to facilitate the locating of freight when called for. Large customers and transfer companies sometimes have special floor space assigned to them, thus aiding the draymen to quickly locate and remove the freight.

The sectionalization may take two forms as follows:[1]

1 Alphabetic location. The space is divided up and marked alphabetically. Freight is stowed according to the names of the consignees. The teamster hauling J. Brown's freight will go directly to the floor nearest to section B.

1 Kirkpatrick, E.E. Station Agents Handbook P.46

7. Freight house door location. All freight house doors on both sides are numbered consecutively commencing with #1. each door has four locations (1) space to the right of the door; (2) space to the left of the door; (3) space to the right of the door toward the center; (4) space to he left of the door toward the center. This

L	R
L/C	R/C

arrangement requires showing the door loaation on the waybill, freight bill, or tally-sheet. It has the advantage in that it enables the stowing of freight near the place where it is unloaded from the cars, thus saving trucking distance.

In unloading way freight, the peddler cars are spotted at the small station platforms. The waybills usually accompany the freight in the care of the conductor who delivers them to the station agent After the seals are examined by the agent, the cars are opened and the freight is unloaded by the train crew who calls off the names of the articles and the consignees. The freight is checked against the waybills and exceptions noted. If any freight is found damaged, a notation to that effect should be indorsed on the waybill and acknowledged by the conductor.

A great danger in unloading peddler cars lies in the fact that unless closely followed up, the employee after unloading a half car, will often leave the remainder three or four tiers high instead of breaking it down and arranging it so that it will not become damaged when the car is moved. Again, in setting out cars as empties, they must be examined to see that no freight remains in them.

The C. L. freight is unloaded by the consignees. The latter are however, not always prompt in unloading cars after they are received. Unless the railroads actively interfere, advantage is often taken by the shippers and the cars are used practically as warehouses, the contents being left in the cars until the sale has been effected. To prevent this abuse and to insure the quick release of cars, the demurrage charge must be strictly enforced. The collection of the demurrage charges may be placed in the hand of a Car Service Association so as to eliminate favoritism.

In the case of L. C. L. freight, it is customary to notify the consignees of the arrival of the cars as soon as the yardmaster reports the cars on hand. The notice to consignees shows when free time will expire and contains a special request to release the car without delay. Although the shippers are expected to be punctual, yet the carriers are also supposed to keep their promises. Should teams arrive at the station and find that the cars are not available for unloading the consignee should claim that the carriers be responsible for the expense of teams not to mention the dissatisfaction to customers waiting supplies who are perhaps obliged to purchase elsewhere.

Delay in placing L. C. L. cars for handling will increase the station cost for handling, as a minimum rate must be paid if the freight is not available, also causing discontent among the freight handlers, as they are anxious to be active in order to raise the wage above the minimum payment.

The freight agent must arrange with the transportation department to furnish a list of the available cars that can be placed for unloading during the night and the following morning; the waybills to be charged on the accounts for the cars designated, and the consignees notified. The yard list from the yardmaster should be ready about 4 o'clock each afternoon.

The inevitable irregularity of the flow of freight generally accounts for the delay in loading and unloading. Since the inbound freight must be unloaded and delivered to the consignees early in the morning, to permit of its distribution, the work is exceedingly heavy during the early hours in the morning and gradually falls off during the remainder of the day. The outbound freight on the other hand always is rushed to the station late in the afternoon, resulting in heavy congestion in the outbound freight house. Again, the irregularity [illegible] the difference in distance between the point of origin and destination of the freight. The congestion and delay can generally be minimized somewhat by the transferring of force from the outbound to inbound platform or vice versa.

Delivery of Freight

If the freight is accompanied by waybills other than the regular waybills, steps must be taken at once to procure the regular billing before the delivery is made. The regular bills when received must be [illegible]
[illegible]

cations and rates being made upon it. The matter of revision is of great importance. Correct charges must be made at destination without incurring loss on the part of the railroad and over-assessment on the part of the shippers.

"Immediate Notice of Arrival must be given to the consignees covering freight ready for delivery. When practicable, receipt for such notice should be obtained. If sent by U. S. Mail, a carbon copy of the notice should be retained, together with record showing date, time, place, and by whom such notice was made and mailed.

"Notice must be given in writing unless the consignee is willing to accept verbal or telephone notice. In such case there must be written agreement to that effect on file in order to legalize such verbal or telephone notice, and when such notice is given, a record must be made and kept showing the time and the person receiving the same.

"Straight consignment of freight shall be delivered on surrender of original bill of lading or other satisfactory proof of ownership, together with written order of consignee. Order Notify consignment must be delivered only upon surrender of the original bill of lading properly indorsed; the bill of lading to be immediately cancelled upon its surrender. Freight billed in bond (account of Custom Duties) must not be delivered until released by Custom House authorities."[1]

After the waybill has been revised, a freight bill is delivered to the Delivery Order Clerk of the Cash Department. The freight bill is a transcript of the waybill or an itemized statement of the charges incidental to transportation of property, showing service rendered and

[1] Pennsylvania Railroad Talks Vol. 1 No. 2 P. 9

on which the carrier makes collection. It virtually carries all the items on the waybill except "bad order" and "short" notations. The consignee, or his representative, who comes for the freight, goes first to the Delivery Order Clerk. The latter, upon being satisfied with the identification of the consignee, collects all charges in full and then signs the Receipt for Charge, that part of the freight bill which entitles the consignee to obtain the freight.

The freight house foreman who makes the actual delivery of freight, must require the consignee to exhibit the receipted freight bill or decline to deliver the freight.

The numbers and initials of all the cars set at the house for unloading are noted in a book in the foreman's office, showing opposite each particular car its section for unloading. The freight bills for transfer or connecting lines when sent to the foreman's office are numbered with the section in which the car is unloaded. The freight bill for city freight when taken from the Delivery Order Clerk by the consignee, is presented at the window of the foreman's office where a clerk puts on the section number showing the location of the freight. When the consignee obtains the freight, he must sign the delivery-receipt before he leaves the house.

Delivery of C. L. freight at private industry tracks or outlying team tracks will be made without check. Any exception must be reported by the consignee at time of unloading to enable the carrier to verify.

In most of the inbound houses a large amount of freight is left

away every day. Despite the storage charge the delivery is by no means expedited. Several reasons may account for this.1

1 The notice of arrival may not be issued in time leaving the consignee in ignorance of the arrival of shipment.

2 The teams of the consignees may be too much engaged to make quick delivery.

3 The wholesaler may have customers located in different towns for want of large space, he utilizes the freight house as a distribution center.

4 There may be wholesale speculators who order goods but are not provided with sufficient funds for warehouse storage.

5 The consignee of L. C. L. freight may be reluctant in taking away his packages for want of space.

6. In case of Order Consign shipment, the consignee may fail to take up the bill of lading at the bank, and the agent justifiably refuses to let the shipment pass out of his hand until the bill of lading is surrendered.

7 The unclaimed, refused, over, and damaged freight may be piled up awaiting disposal.

The remedies for the delay in delivery necessarily require:

1 The speeding up of office work

2 The extensive utilization of the storage warehouse; in the Walnut-Dock Street freight station of the Pennsylvania Railroad, inbound freight is piled in the freight car for a period not over [illegible] hours, after which it must be removed to the warehouse, shipments com-

1 Byers, M. C. Economics of Railway Operation P 522

ing in on Monday morning, when not delivered, are removed to the warehouse early in Thursday morning.[1]

3 The periodical checking of the freight house to avoid the accumulation of unclaimed, refused, or astray freight, which must be piled in a specially convenient [illegible] disposal.

4 The quick settlement of unclaimed, astray, and refused freight.

5 The provision of delivery facilities such as store-door delivery, which has been practised successfully by a few railroads

6 The cooperation of the consignee in speeding up the movement.

Transfer Station

A transfer station is "a station established at a convenient point where freight from various stations and converging lines centralizes and may be consolidated into either "straight" cars for its destination or transfer, or into "peddler" cars to be distributed over the various way freight runs". The transfer station is usually operated in conjunction with a freight stationn under one general head, although the larger and more inportant transfers are often operated independently. A regular "set-up" is made daily at a transfer; the inbound cars when unloaded, ordinarily being utilized to make the outbound "set-up". The proper arrangement of car loading at transfer to secure the maximum car load with a minimum car-mileage is quite a difficult problem. [illegible]

1 Information given by Mr. [illegible], [illegible]

by many side lines and junctions, any arrangement must have some disadvantages, and all require constant revision to meet changing conditions. The transfer station of New Haven at Cedar Hill, the largest transfer station in the East, has an elaborate system carefully planned to meet the most complicated and exacting conditions of handling package freight in this country. The following description of its operation is taken from J. A. Droege's Freight Terminals and Trains.

"The merchandise cars destined for the transfer arrive at both the east and westbound hump yards continuously throughout a 24 hour period. On arrival, the cars are switched to classification tracks, where they are arranged according to the route to be followed when forwarded from the transfer, and are so planned on the transfer tracks. The block numbering system for cars at the house is simple and easily understood by the men. The last figure in the house indicates the number of the track, and the preceding figures the relative position of the cars on the track, the outbound classification being confined to tracks 3 to 9 inclusive, with the other tracks accomodating the inbound loaded cars which are to be worked.

"For example, the northernly car on track #3 receives the number 13; the corresponding car on track #4 receives the number 14; the second car from the north end of track #3 receives the block number 23 and so on up to block number 263, indicating car 26 on track #3, numbered from the north. Block numbers are posted conspicuously on each platform.

"The house organization is headed by an assistant agent, assisted by a general foreman reporting to the agent and consists of a day and night force, the latter being limited to office help only.

"Messenger service is maintained between the two hump offices and the transfer office for carrying waybill pouches. A book record of each pouch, arranged according to the last two figures of the car number, is kept. It includes the date of receipt of bills and the point of origin. The record is completed later with the addition of the cars as placed at the platform and the date of handling. This is done so that tracing work, when necessary, may be expedited.

"The daily layout sheet of the transfer is made up by the night force as the tracks are filled. The block numbers showing the location of cars to which the merchandise is to be transferred is noted on the waybill by the route clerks. This number serves as a guide to the tallyman and check clerks when the actual handling of the merchandise is begun. These men are also expected to check the waybills and detect any errors made by the route clerks.

"Waybill pouches are assigned to tallymen by the foreman in charge of the platform where cars covered by the bill are located. The tallymen are required to check the freight as it is handled and note any exceptions as to condition of shortage. The tallyman also makes a check-over-slip for any freight in the car not covered by a revenue waybill. Every package of freight, when placed on trailer is destined.

"The contents of cars are loaded on trailer trucks, the trailers being held until the entire lading of a car has been handled. When the unloading of a car has been completed, the trailers are made up into trains of six or eight placed in loading order -- with the longest haul next to the tractor -- and hauled to the destination. Trailers are dropped from the train on the platform opposite the proper car and are taken into the car and unloaded by stevedores. The stevedores then push the empty trailers out of the cars, onto the platforms, where they are picked up by the tractors. The stevedores are assigned to the same car each day, and become familiar with the destination of the freight that belongs to their cars. They are required to examine both the marking on freight and the chalk marks placed on packages by check clerks, and to report for correction any freight trucked to them in error.

"As an additional check on destination, three qualified tallymen act as inspectors. These men make the rounds of the cars and inspect the loading and stowing, to correct apparent errors.

"As the cars are worked, tonnage on waybills is computed and totaled at the end of the day, the total showing the tonnage actually transferred, tonnage travelling without revenue billing, tonnage left in cars and the amount checking short according to the waybills.

"The bills then pass on to the exception clerks, and any exception made by the tallymen is recorded. The bills are then racked, by the pouching clerks, and at the close of business are examined by

the rack clerks before being pouched. Each rack clerk is required to note the block numbers of cars he verifies, thus making it easy to place the responsibility for improper pouching.

"At the close of business switching, requests are made on a standard form showing the track number, date, the initials and number of the cars as they stand on the tracks, the destination, route, and other essential information. Platform foremen are required to check the switching requests against their records, and the rack men are required to check the pouches against the switching request which is retained in the office. The forms are then passed to the yard department.

"The General Instructions showing the handling of transfer read as follows:

1 "Hours for receipt and delivery of L. C. L. freight will be arranged to meet prevailing conditions and must be such as in a reasonably satisfactory way meet the requirements of shippers and receivers of freight.

2 "L. C. L. freight should be loaded and forwarded the same day as tendered for shipment to the fullest practical extent. Where way freight movement is involved, agents will acquaint shippers with approximate time of departure of such service that shipments may be tendered sufficiently in advance to enable waybilling and loading thereof. Shipments offered after the departure of way freights should be promptly accepted when tendered within the prescribed [illegible]

held for forwarding by next regular movement.

3 "Where tri-weekly cars are in effect for purpose of avoiding a transfer en route, agents should arrange with shippers that, as far as practicable, freight for such cars may be delivered on the date car goes forward. If shippers prefer daily deliveries, freight should be accepted and forwarded according to arrangement.

4 "L. C. L. freight must be loaded in accordance with routings shown on shipping orders or waybills and agents should see accordingly that this is understood by their freight house forces.

5 "Agents should observe both the inward and outward movement of L. C. L. cars and report to the Superintendent of Transportation on post cards provided therefor any arranged cars, the tonnage for which does not appear to warrant their continuance, or where freight has met with a delay en route to an extent that will cause loss of business to other means of transportation or complaints from shippers or consignees.

6 "In order to avoid liability of damage resulting to such commodities as flour, sugar and other food products, through the absorbtion of odors or by direct contact, shipments of oil, fertilizer, hides, tar, creosote, and empty oil containers should, so far as possible, be transported in stock or rough freight equipment. In order to accomplish this, such freight may be held for consolidation."[1]

[1] Droege, J. A., Freight Terminals and Trains p. 380

Over, short, damaged, refused and unclaimed freight.[1]

The "over" freight can be classified into three kinds, namely: astray freight; over freight; excess freight.

Astray freight is L. C. L. freight which is marked for destination and which has become separated from the regular revenue waybill, and C. L. freight which has become separated from billing. Astray freight, less than carload, must be forwarded immediately in accordance with marks to its destination on astray waybill (except perishable freight which can not be forwarded without loss and which must be disposed of according to regulations) showing number and initial of car being checked over, car seals, name of station from which received, if known, weight of shipment, description of articles, and with the following notation "Deliver only on presentation of original bill of lading or other proof of ownership". If a shipment checks at destination, properly marked, with no billing, a Station to Station astray waybill should be issued and charges forced according to regulations. A station index should be kept for the purpose of recording overs and shorts.

Over freight without marks is freight which is found at any point without markings and without revenue waybill. A complete description of such freight must be obtained, and should packages be opened for such information as may afford proper disposition, and all facts reported to proper officer. After ten days it must be sent

1 Pennsylvania Railroad Talks Vol. 1 Talk #2

to the Unclaimed Freight Station. Over freight with marks is freight over at destination without revenue billing. A report must be made within five days after arrival of shipment and a copy sent to Agent at point of shipment, requesting revenue billing. A notice of arrival is also sent to consignee requesting him to call and prove ownership. After 30 days it is sent to public storage.

Excess freight is freight with or without marks which checks in excess of quality on regular revenue billing. Reports must be made and one copy sent to Agent at point of shipment to ascertain if an error in billing was made. Overages should be weighed to determine whether or not revenue has been assessed to cover.

Short freight. When freight is checked at destination, any shortage must be immediately recorded. Every effort must be exerted to locate shortage and check the warehouse at short intervals to locate irregularities. The checking of the warehouse should be by the examination and record of each package and not by checking the delivery order with the packages on the floor. Shortages caused by theft should be immediately reported and those pilfered should be carefully checked with consignee's invoice before delivery, or by carrier's representative at consignee's place of business in order that claim for loss may be verified. Shortages received should be immediately endorsed on station record and reported.

Damaged freight. Bad order freight, when received, must be prevented from further damage, and complete record made of its con-

ditions. The extent of damage and its cause must be ascertained by inventory, weighing, and other methods of investigation. Freight that has been damaged at receiving station must not be forwarded, but for disposition requested from shipper.

Refused and unclaimed freight. Non-perishable L. C. L. freight when unclaimed, must be reported to the forwarding agent, who will endeavor to obtain disposal order. If not disposed of, it must be forwarded to the freight claim agent. Non-perishable C.L. freight for non-resident or unknown consignees, when unclaimed, must be reported. Perishables and freight subject to deterioration shall be disposed of according to regulations before they become worthless. Freight must not be returned or reshipped without surrender of original bill of lading or instruction by proper authority.[1] The best way to dispose of the refused freight will be to induce the consignee to accept it and settle the discrepancy by the claims.

Claims for Loss, Damage, and Overcharge.

A claim is a demand filed by a shipper of a right to recover from a carrier for loss and damage to freight or for the application of erroneous rates. The Interstate Commerce Commission figures show that a number of the large railroads pay in excess of a million dollars yearly in the settlement of freight claims. Many railroads pay out as much as 2.5% to 3% of their total freight revenue in the

1 Pennsylvania Railroad [illegible]

settlement of these claims.

The loss and damage claims may take three forms, namely:

1 Those known, that is , physical loss or damage which is evident at the time of delivery by the carrier or which is known by the carrier's complete failure to make delivery.

2 Those concealed, that is physical loss or damage not known until the consignee has opened the container and checked the contents.

3 Those caused by delay, which is economic loss arising from changes in values to the disadvantage of the consignee or consignor.[1]

The causes for loss and damage may be enumerated as follows:

1 Lack of interest by employes.

2 Lack of knowledge of the rules.

3 Failure to comply with rules.

4 Failure to check property upon receipt.

5 Receipting for more than is actually delivered.

6 Receipting bad order goods without notation.

7 Issuing clean receipt for shipper's load without checking.

8 Loading freight in unfit equipment.

9 Careless inspection of cars.

10 Rough handling.

11 Poor packing.

12 Poor stowing.

13 Inadequate protection of perishables.

1 [illegible], [illegible]. Business of Railway Transportation P.[illegible]

14 Wrong billing caused by failure to compare waybill with shipping instructions.

15 Misrouting.

16 Faulty marking.

17 Delay in transit.

18 Failure in issuing notice of arrival and keeping record thereof.

19 Delivery to wrong person without proper order.

20 Failure to check freight when delivered to consignee

21 Making greater advance on property than the value warrants.

22 Careless transmitting of shipping instructions.

23 Failure to report overage, shortage, and damage promptly.

24 Theft.

25 Dishonesty of consignees and employees.

26 Improper use of airbrakes.

27 Car shortage.

28 Shipping to over-supplied market.

29 Delivering Order Consign shipment without requiring the surrender of the Bill of Lading properly endorsed.[1]

According to the loss and damage statistics in [illegible], the causes for loss and damage are found to be in the following order:

Rough handling and unlocated damage	[illegible]%
Delays	1[illegible]%
Defective equipment	11.[illegible]%
Loss of entire package	[illegible]%

1 Droege: Freight Terminals and Trains p.[illegible]; [illegible] p. [illegible]

For the prevention of loss and damage, the following measures may be taken.

1 Using standard ballot system to prevent improper loading.

2 Instituting an uniform method of designating the location of cars for loading at stations and transfers.

3 Setting rules for receiving, stowing, and delivering freight.

4 Checking freight house periodically and keeping record [illegible]

5 Using standard forms for the policing of car movement to prevent delay.

6 Requiring the reports of the analysis of claims paid to enable the administration of corrective action.

7 Requiring the forwarding of astray freight direct to destination, avoiding the accumulation at intermediate points.

8 Watching the over and damaged freight at small stations by the interchange of over reports and meeting of agents; at large stations thru the over and short bureaus.

9 Inaugurating campaigns to prohibit the accepting of freight improperly packed or marked.

10 Joining the Transportation Association which provides for standard containers and loading rules.

11 Requiring continuous reports of analysis of freight loaded thru transfer station for the purpose of eliminating such freight as should logically be loaded direct to destination.

12 Inspecting the operation at each freight station, and holding periodical conferences among the agents to discuss improvements.

As regards the overcharge claim, it may on shipment be given the wrong classification or rating thru error in quoting the tariff or thru faulty routing; it may be given an erroneous weight or a mistake made in the calculation. However, they all involve the rate that is charged but not loss of or damage to the shipment.

Store-door Delivery and Container Car system

By store door delivery is meant the delivery and collection of freight by the carrier to and from the door of the shipper. A container car is one which carries two or more separate and removable containers which can be transferred bodily with their contents to motor trucks. The container car goes with storedoor delivery, but the latter does not not require the container system. It is believed that these two devices would greatly help to increase economy and speed in terminal freight handling.

The English railways, as a rule, include the delivery of L.C.L. freight in the regular service. The Canadian roads have followed the practice with good results, and for many years up to 1918 store-door delivery was made by railroads in Baltimore and Washington, and it has recently been adopted in a limited way by the Erie at New York City and other roads at St.Louis and Cincinnati. The container system has been used by the New Yoek Central and other roads for certain traffic

The advantages of store-door delivery are as follows:

1 Relief of congestion of terminals and streets. A large volume of freight would not need to pass thru the freight houses. The freight house facilities required would be minimized and the same platform could be used for both inbound and outbound freight.

2 More expeditious movement of freight.

3 Great economy in handling by centralization and elimination of duplications. It enables the continuous utilization of trucks. When each shipper does his own trucking, twice as many trucks may be required to cover a single block as would be required if ~~tf~~ the carrier did the work.

However, the system meets the following objections:

1 Increased cost.

2 The difficulty in delivering packages in high buildings or deep basements.

3 The confusion arising from the delivery to consignees having warehouses in different localities.

4 The time of making the delivery may cause friction: some shippers desire notice of arrival of their goods before the actual delivery is made.

5 Small trucking companies fear the loss of an important part of their business.

6 Large concerns equipped to do their own trucking believe that their own hauling is cheaper.

7 Railroads have not desired to assume the liabilities of truckmen in addition to those they now bear.

The good points that can be said of the container system may be the following:

1 Saving break-bulk at terminals and unnecessary handling which is very burdensome in the case of short haul L.C.L. freight.

2 Minimizing the amount of package required.

3 Reducing rough handling and damage.

4 Decreasing trucking mileage.

5 Reducing tallying and checking processes.

6 Expediting loading and unloading movements. The car trucks (running gears and all) (?) can make a greater mileage than [illegible] car. Containers may be loaded and unloaded in [illegible] of the time required for filling a box car by hand trucks.

The system on the other hand, is objected to for the following reasons:

1 Large initial cost.

2 Necessity of accepting goods on the basis of shipper's load and count.

3 Difficulty in collecting freight charges.

4 Limited dimensions: unable to accommodate large size freight.

At present, the store-door delivery service is experimental and a [illegible], and, in the opinion of the Interstate Commerce Commission, the carriers are not obligated to perform such service. However, [illegible]

the growth in traffic and congestion in the large cities, the facility of luxurious service may soon turn into a necessity. The container system would naturally follow the store-door delivery, but due to its high cost, it might be confined only to certain traffic.[1]

Mechanical Appliances for Freight Handling.

Mechanical appliances are devised for the economical handling of freight at terminals with three objects in view. (1) the utilization of all possible floor space for storgge purposes; (2) the transportation of freight from any point in the house to any other point in the house; (3) the handling of packages of various sizes, shapes, and weights.

Appliances for handling L.C.L. freight.

1 The ordinary two-wheeled hand truck is one of the most useful implements, especially in small freight houses with cramped and narrow runways, altho it has been displaced to some extent by

2 the four-wheeled [illegible] truck gradually [illegible], as a result of the substitution of the [illegible] system for [illegible]. The latter truck has an average loading three time the two-wheeled hand truck.

3 The trailer trucks hauled by electric tractor, have partially displaced the hand-power trucks. They greatly relieve the congestion during the rush hours and eliminate the consideration of the "distance to be traversed" feature. Trailer train should be operated in units of from three to eight traibers depending upon the block classification, floor condition, grades to be overcome and other considerations

1 Haney; Business of Railway Transportation
Coree: Railroad Freight Transporation

On the return trip, it is important that the tractor bring back to the platform approximately the same number of empty trailers so as to keep a supply available.

4 The load-carrying truck is operated by electric power like the tractor but has less potential power. "The platform is a part of the truck, having about the same flooring space as the trailers. Freight is loaded onto the platform, the truck is moved to the car or house destination, the freight is removed, and the truck returns for another load".

5 The electric lift truck is designed to work in connection with stationary platforms or skid. "The lift of the truck can [illegible] underneath the skid and, by raising the lift, the platform is hoisted clear of the floor, and the lift truck with its two units becomes a load carrier. Upon arrival at its destination, the lift is dropped and the skid placed on the floor, there it remains until unloaded. The skid can be equipped with wheels, thus becoming live and capable of being pushed and pulled about by hands".

6 The elevating or tiering truck is a combined load carrier and lift truck, which can elevate freight and place it onto piles at varying heights.

7 The hand-lift truck is similar to elevating truck but is much lighter and is operated by hand power.

Appliances for handling C.L.freight.

1 Conveyors are used for moving from one point to another

freight of one general class such as flour in barrels.

2 Overhead cranes or gantrys are used for heavy freight moving on constant path with slight variation in distance as on water fronts

3 The overhead mono-rail, or carrier, system with independent motor for lifting and propelling, is adopted for hauling packages of various sizes, shapes, and weights.

4 The conveyor system is not adaptable to changing conditions. At a transfer station it may be necessary to convey the contents of one car, often in small loads, into any of 200 cars or from any of the 200 cars into one car. This problem is solved by the use of the electric carrier and movable by-path track. Altho the action of these electric carriers and trailers is almost continuous, yet each train being independent, an accident to one does not stop operation for a minute.

5 The movable platform, another piece of machinery for handling freight between variable points, can be used either to move the freight itself when loaded on the movable platform, or to move the track on which it is loaded.

6 Another type is "a traveling platform level with the floor moving at slow speed, so that men, trucks and teams can cross it. It may form a belt line; one side near the truck side and the other near the team track delivery side. Packages or trucks would be dropped on it. The house would be divided into sections with a man to each, and each man would pull from the platform the freight for his section as it passes".

7. A traveling chain is devised to take freight from any car along the platform and deliver it to any other car. The freight is loaded on a hand truck which is manually placed on a narrowed gage track attached to an endless chain hidden underneath the floor.

8. Mechanical freight handlers are used for loading and unloading vessels, adjustable to the height of tide and of vessels.

For mechanical appliances of freight handling refer to Droege, J.A. Freight Terminals and Trains [illegible]

[illegible]

[illegible]

Classification of Cars

Advanced Information or "Consist"

Prior Classification

"No-bill" Cars

Cars of excessive Dimensions

Weighing of Cars

Shop Cars

[illegible]

Checking of Yards

Embargo

Export and Import Freight Handling

Overtime and Respite

Switching

Definition of the Term

Switch List and Switching Procedure

Line-haul Switching

Outbound Car handling and Systems of Train Make-up

Local Train make-up

Through Train Make-up

Mixed Loads and Empties

Flat Cars

[illegible]

Live Stock Cars

Inflammables and Explosives Cars

Passenger Cars on Freight Trains

Rough Handling

Yard Engine Movement

Engine Schedule

Follow-up Engine Movement

Train sheets

Record Board

Assignment of Yard Power

Relief Engines

Balancing Yard Engines and Forces

Yard Congestion

Causes of Congestion and Meatures for Relief

Efficient Yard Operation

CHAPTER III YARD OPERATION

Whereas the station operation mainly involves the handling of freight, the yard operation is concerned with the disposition of cars. Cars in the inbound trains are received, classified, and disposed of according to individual requirements such as,

1 Engines--to be moved to engine house;

2 Cabooses--to be moved to caboose tracks;

3 Cars to be forwarded to other trains;

4 Cars to be held for orders;

5 Cars for Freight Houses and team-tracks;

6 Cars for connections;

7 Cars for industries;

8 Empty cars to be stored until needed;

9 Cars to be weighed;

10 Cars to be repaired;

11 Cars to be transferred; etc.

Outbound cars are collected from freight houses, team-tracks, industry tracks, and interchange lines, and assembled into trains for outbound movements.

Inbound Car Handling

Classification of Cars. A train is pulled into the receiving yard. The road engine is detached by a member of the train crew and sent to the pit or to engine house, usually taking with it the caboose to the caboose track on its way.

The train is immediately blue-flagged by the Inspectors who divide the train in parts and make a thorough study of each car, making minor repairs such as are possible for them to make without undue delay to cars. The time for inspection is about an hour.

Meanwhile, a number-taker makes out a list of the number and initials of cars in the train, and notes the conditions of the loads on open cars, and records the seals attached to them. All the seal numbers or letters are taken and a copy made in an impression book fo for future reference.

The train clerk, or classification clerk, carefully examines the waybills for "hold" or "diversion" orders, and makes a transcript of them on a train sheet, stating the car number, initials, forwarding station, destination, contents, and the connecting line to be used. He then issues "cut-slips" for the train to the car-marker, the checke and the switch-man in the tower.

The carder then tacks on each car a card of distinctive color with large letters or numbers indicating the road which the car is to be transferred, or, should it be destined for home road, the switching district to which it is to be taken.

The yard engine then pushes the train onto the hump in the classification yard. The car-marker marks the cars according to the cut-slip. The method used by the Pennsylvania Railroad is to mark with chalk on the side of the front-end of the car the number of cars in the cut, followed by the letter "X" and this being followed

by the number of the track on which the cut is to be run. The car-dropper, on seeing this mark, is enabled to know on what tracks they are to go and is also enabled to determine how many riders are necessary to properly man the cut. On the rear end of the cut, the car marker usually places the number of the front cut. This serves as an indication to the car cutter who is located near the apex of the hump, where the cut is to be made. In case the car-marker finds a car in the cut bearing "shop tag" put on it by the Inspector, he marks the car for the shop track and places a circle around the track number on the preceding cut, the swictch-man in the tower, on seeing this circle, would know that the following car is for the shop track.

The cuts are detached and switched by gravity, into various classification tracks, each taking the cars for a particular destination.

"In switching over a hump, a uniform speed of about two miles per hour should be maintained without a stop, until all the riders are taken up. If cars do not run freely, a second engine, equipped for poling, may be placed alongside the ladder and used to good advantage in starting stopped cars and keeping switches and entrance to the track open. with low temperatures or during a heavy storm, this will greatly aid the movement."[1]

1 Droege, J.A. Freight Terminals and Trains Chapter 6
For the Classification of Car see Pennsylvania Railroad Talks.
Vol. 2 p. 116; Dewsnup, E.R. Railway Organisation and working p. 76

Advanced information or "consist". The yardmaster and his forces should be kept posted on the time of arrival of trains, number of cars, cars of stock, or perishable shipments, and crews having time near the expiration of the 16-hour period, and the make-up of train, etc. This advanced information or "consist" is very valuable and necessary in enabling them to arrange for their reception and proper handling to the best advantage and with little delay. This is especially important in case of thru trains which require quick movement thru yards. Below is the expression of an officer of the Baltimore and Ohio Railway regarding the importance of "consist".

"Most of the freight trains do not maintain their regular schedules. The reason is that there is no consist or generally understood plan as to how these trains should be made up. Hence, at the different divisional points, they have to be taken off the main tracks and put into the yards for switching and for made up over again, largely in accord with the conditions obtaining in the yard in question at the time and in accord with the judgment of the officers in charge.

"Two consist forms are supplied for the use of officers and trainmen involved in handling, one for trains dispatched from yard to yard eastward, and the other westward. These consists contain various symbols used for slow freight, roof top equipment, open top equipment, quick dispatch, and a special consist for yard master and train dispatcher to show any special equipment moving in the train,

such as dead engines, passenger equipment, live stock, etc.

"When the train leaves the station, the consist of the train is immediately given by wire to the yardmaster in the next yard who will classify and assemble the cars to be added to the train, so that when the train arrives, it is directly main-tracked. As soon as it departs for the third yard, the second yard sends the consist to the third."[1]

This certainly would result in saving time, labor and expense, and a regular and quick schedule to attract more traffic.

Prior classification. Trains arriving with cars blocked for one common point will greatly facilitate yard handling. It minimizes classification processes and assures prompt switching and delivery. Thus, prior classification is highly desirable. If each yard could, as much as possible, classify cars for similar destinations, and group them before forwarding, the next yard, and in turn all the yards, would be benefited. Of course, some yards may have their particular handicaps and difficulties in realizing the desired results.[2]

"No-bill" cars. Cars arriving with card waybills or with illegal or improperly prepared cards require special attention in handling. Sending cars without proper waybills is an inexcusable fault on the part of the forwarding yard, due to careless billing and inaccurate checking. Upon the arrival of "no-bill" cars, the road must be scoured to locate the billing. The Central Card Record Office may

1 Baltimore and Ohio Proceedings July 1921

2 Pennsylvania Railroad Talks Vol. 2 P. 123

be consulted in order to locate the point of origin for securing the duplicate waybills or for correcting illegible billing.

Cars of excessive dimensions. In receiving cars of excessive dimensions, which can not travel over normal routes to destination, care must be taken to secure a route with sufficient overhead and side clearance to accommodate them to destination; or otherwise, the lading must be transferred to smaller cars.

Weighing of cars. Great care is required in weighing cars. The scales must be balanced before using; and free from obstruction; cars must be brought to a stand-still, and be free at both ends; and the beams must be properly balanced. Cars should not be bumped off the scales by an engine or other car on a dead rail. When pushing off the scales, cars must not run at greater speed than two miles an hour. After weighing, record will be taken and kept for reference in the yardmaster's office.

Shop cars. Cars with shop-tags must be immediately switched to the round house for repair. The yard conductor shall furnish a report showing the numbers and initials of cars and the time cars are placed or removed from the repair tracks.

Hold cars. Certain cars are held on hold tracks awaiting disposal, and may be held for the following reasons: (1) nonpayment of freight charges; (2) cars containing Order Notify shipments awaiting the presentation of the endorsed bill of lading; (3) over-loaded cars; (4) cars of excessive dimensions. These cars must be

held in compliance with the Agent's instructions and kept under close observation, otherwise, much trouble will arise in collecting freight charges.

Checking of yards. The yards must be checked once every 24 hours, so that no car can be overlooked. All cars shall be recorded and marked and seal impression noted, so that cars may be switched and disposed of in due time, and tracing may also be facilitated.

Embargo. In case of unusually heavy traffic, which threatens congestion or blockade in the yard, an embargo may be placed on all freight until the situation is eliminated sufficiently to release the yard, when freight will then move in the regular way. The notice of embargo is issued by the agent, and it shall be complied with. Cars arriving contrary to instruction must be stopped and disposed of before entering the yard.

Export and import freight handling. The handling of export and import freight demands close observation and foresight. In order to secure sufficient freight on hand for prompt loading into steamers and required empty cars to receive it, eliminating congestion and avoiding delay, the fluctuation of traffic must be closely watched, and proper arrangements made in advance. At times, it may be necessary to place embargoes to freight due to late arrival and departure of vessels in order to reduce exorbitant charges.

Hour of service , overtime, and respite. The working time

of the crews should never be neglected. Crews arriving near the end of ther 16-hour period should be properly released before violations of the Hour of Service law occur. Overtime is mostly due to the lack of preparation to receive a train upon its arrival at the gateway of the yard and the absence of advanced information by the connecting divisions. In case of unusual conditions, such as engine failure, wrecks, etc., crews after being called may be given respite for a definite period of time. But it must be lifted in time to have trains in readiness to leave.

Switching

Terminal switching is the movement of cars between points within the switching limits of a station. Its purpose is to handle equipment in the yard as traffic conditions require: to place cars properly for unloading, for loading, for forwarding, for transfer to connecting lines, for weighing, for storage, for cleaning, for undergoing repairs, etc. Cars may be moved, say from the passing tracks to the house tracks, team-tracks, elevator tracks, and transfer tracks, or from the various tracks to the passing tracks on which are made up the outgoing trains.

At smaller stations, switching is done be ordinary train crews. At large stations, switching becomes a system of operation under the supervision of the yardmaster. In either case, it must follow the direction of the station agent and the train dispatcher. The latter issues instructions concerning switching operation as to the picking

up of cars for which the agent has no use and which are needed at points along the line of the road. These instructions may be incorporated with those of the agent, and they are to be complied with when received. The instructins are contained in a formal document known as the "switch list". They must be perfectly correct, clear and concise. For their proper preparation and execution, the various locations of the yard--tracks and industry sidings--and the changing conditions therein, must be familiarized by all concerned. The daily yard check may offer great assistance in the making up of train list.

In directing the switching in yard, attention must be called to the following points:

1 Careful utilization must be made of the limited space on the house tracks and transfer tracks.

2 The switching of cars to the connecting lines over the transfer points must be constantly watched to prevent delay and controversy.

3 Cars, when disturbed during switching operation, must be replaced in their proper position.

Line-haul switching is the placing of cars in train to be forwarded to certain point. In this case, in addition to the instruction contained in the switching list, as to the destination and contents of the cars, billing should be given to the conductor, authorizing and explaining the future disposition of cars and their contents. Without such billing, the conductor has no authority for moving the cars

[illegible]

[illegible]

[illegible] classification yard; [illegible]

[illegible]

[illegible] the cars are called off by telephone to the di[illegible]

[illegible] boxes the manifests which have been [illegible] the "[illegible]" [illegible] the cut-slips are made [illegible] have been boxed for the various tracks, the [illegible] Dispatcher's report. [illegible], and having already previous [illegible] formation as to the number of car for the various classification, [illegible] of the train; [illegible] set out, [illegible]

[illegible]

[illegible]

1. [illegible]
2. [illegible] freight, etc.)
3. [illegible]

4 the system of train make-up employed.

The train into which the cars should be moved is determined by the rules governing the routing of cars, the method of handling the special service cars, and train schedules.

As regards make-up of trains, the principle is to arrange cars so as to permit of the quickest, cheapest, and safest movement from the point of origin to the point of destination.

In local trains, those which are particularly engaged in picking [illegible] and setting off cars between yards, the make-up should be in station order with the first car to be set off next to the engine and the remaining cars in regular rotation, since much time is saved in [illegible] the road by the reduction of time necessary to set [illegible]. However, the yard work is increased where it is necessary to switch cars in station order instead of indiscriminately as received. But since yards are provided for the particular purpose of [illegible] road, it is [illegible] yard rather than extend it to the road, where the delay will inconvenience the other trains. "The practice of getting train out of a yard as a matter of convenience to that partcular yard, alone, and without regard to the burden on the next yard and delay over the line, can not be condemned too severely. The only excuse would be for yards with facilities so inadequate that a part of its work must [illegible] to another yard."

[illegible]

[illegible]
[illegible]he first yard, the policy is(1) to make up "solid" of cars to go [illegible] a single destination, as this expedites the movement, altho it [illegible] solid [illegible]in; (2) where it is impracticable to make up a train with all its [illegible] for one destination, the cars should be assembled with a view [illegible]ning the train without further switching, to the most distant [illegible] up point possible. This policy, however, has its limitation [illegible] following respects: (1) the time cars may be held to get enough [illegible]her for one destination or breaking-up point; (2) the inability [illegible] the facilities provided, at the starting point, to hold cars for [illegible] purpose without causing congestion or interference to an extent [illegible]t will increase the cost of switching; (3) the needs of the con-[illegible].

Sometimes, advantage can be taken of the consignees' habit of [illegible]t working on Sundays or during the nights. For this purpose, cars [illegible] on their sidings, on team tracks, or at the freight house, may [illegible]

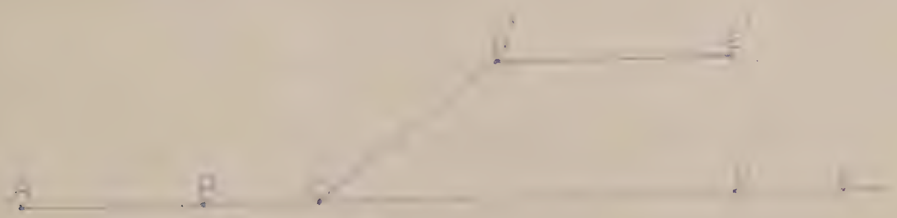
[illegible]

1 "No classification is made until the point of the run which [illegible] a delivery of the car is reached, it being left to this yard [illegible] from those going to the yard beyond.

2 "[illegible] grouping of cars together in accordance therewith is begun in the initial yard, and continued in each succedding ones, adding to each group [illegible] cars belonging thereto or which have been picked up since leaving [illegible]."

This second method relieves the work for the terminal but increases considerably the work for all the yards. Its application is permissible only where the final terminal is so overloaded with traffic and cramped in facilities that the work must be shared by the outlying yards.

3 [illegible]



Showing location of yards.

(1) Normally, each yard will classify thru trains into two [illegible]:

(a) [illegible]

[illegible]

[illegible]ly, are [illegible] thru trains [illegible]

yard.

(b) All other cars.

Example---Yard A will make up thru trains for yard B with all cars for yard B (including local cars for points between B and C inclusive) in one cut, and all cars for yard C and beyond in a second cut. Yard B will receive this train, remove the first cut and classify the second cut into :

A 1--Cars for yard D and local beyond D;

A 2--Cars for yard E and beyond.

It will add any cars held in the yard for these destinations to these cuts, and the train is then ready to proceed to yard D. In like manner it will classify other cars of the second cut into:

B 1--Cars for Yard D' and local beyond D'

B 2--Cars for Yard E' and beyond.

It will add any cars held in the yard for these destinations and the branch train is then ready to proceed. Then, at its leisure, it will dispose of the cut set off and switch the cars into the locals, or to the points in the yard as the destination of the cars may indicate

3. (2) If any yard after performing the normal work above indicated has available yard engine time before the departure time of the thru train, it will [illegible] the next [illegible] yard as may be done without delay or increased cost.

Example---Yard A having completed its work in time to do fur-

ther switching on the thru train for B, will separate the second cut (for points beyond C) into

A---Cars for Yard D and beyond;

B---Cars for Yard [illegible] and beyond.

If further time is available, it will separate cut A into cuts $A_{,}$ and $A_{,,}$, and cut B into cuts $B_{,}$ and $B_{,,}$, before mentioned, thus reducing delay at yard C.

The successful execution of this method requires the preparation of a yard-working book, giving the normal classification required of each yard. It also requires sufficient inspection to insure co-operation between yards.

Mixed "loads and empties". It is desirable to confine trains to solid loads or solid empties. In case of mixed loads and empties, it is a debatable question whether the empty cars should be hauled next to the engine or in the rear of the train. An old and good rule is to keep the loads ahead and empties in the rear, as it is believed that the train so made up will pull easily; altho the dynamometer test does not help to ascertain the fact. J.A.Droege believes that "trains made up with loads ahead are less likely to part on hilly or choppy road, and there is less liability of damage to equipment and contents when the slack runs in and out and making stops",[1] whereas

For system of train make-up see Byers: Economics of Railway Operation; Loree: Railroad Freight Transportation; Droege: Freight Terminals and Trains.

1 Droege: Freight Terminals and Trains P. 157

an official of the Pennsylvania Railroad maintains that "a train made up in this way gives bad result in the operation of air-brakes, as the empty cars will offer more resistance, and this often results in damage to trains. It is felt that ease of handling is subordinate to safety of operation, and, when practicable, the empty cars should be hauled ahead and the loaded in the rear for that reason"[1] The Interstate Commerce Commission requires that at least 85% of the cars in all freight train shall be equipped with working air-brakes, and the courts have decided that if a train is equipped with air-brakes, all must be operative.

Flat car handling. Empty oil tanks and empty or loaded gondolas with low sides are required to be kept at the rear end to minimize the liability of such cars having their bodies broken in two, especially when handled in long trains partially air-braked. HOwever, with the modern heavy capacity, steel flat and gondola cars, which will withstand a more severe shock than wooden based cars, the danger is lessened.

Package car handling. Cars containing the break-bulk or package freight are usually placed next to the caboose, altho practice varies considerably in this respect. On heavy local runs, in districts where the track occupation is dense, this plan possesses considerable merits. The front end of the train, may be engaged in doing the switching for the station and industries, while the platform cars are placed alongside the freight house and are worked at the same time.

1 Pennsylvania Railroad Talks Vol. I

Passenger cars on freight trains. They should be kept at the rear end to avoid damaging platform and straining their longtudinal framing.

Live stock cars. They should be handled at or near the front end of the train, to reduce the shocks and facilitate the quick delivering on arrival at destination.

Inflammables in tank cars. (1) "Tank cars containing inflammables must be placed at least five cars from the engine and five cars from the caboose; if the length of the train does not permit this, they must be placed as near the middle of the train as possible. (2) In switching, the cars must not be started down a ladder track, incline, or hump, until the preceding cars have cleared the ladder. They must also clear the ladder before another car is allowed to follow. (3) A diagonal placard must be placed on the sides of the cars."

Explosive cars. (1)"Cars containing explosives must not be hauled in a mixed train (containing freight and passenger cars), (2) They must be fifteen cars away from the engine and ten cars from the caboose. (3) In local trains, they must be coupled with cars in which the air-brakes are operative, and placed as near the train as possible. (5) When handled in yard, they must be coupled to an engine with a car between, and they must not be cut off while in motion; avoiding to stand opposite or near an engine on parallel tracks to prevent the danger of fire. (6) Placards must be placed on the sides

of the cars".[1]

Rough handling

About 40% of the damaged freight is caused by rough handling. In yards where the [illegible] every precaution must be taken to avoid damage to cars or lading. Should any damage occur in the yard, a complete investigation must be made at once to determine the cause and enforce discipline.

Accidents often occur when engines back or push cars and permit them to strike too hard. The enginemen ususally see no stop signal; the trainmen give it in ample time, but it is not obeyed. A good rule is to require the enginemen to consider the disappearance of hand signals when pushing cars ahead of the engine as a stop signal.

Requiring the yardmen to get trains faster, to do more work in a given length of time, usually results in [illegible] damage to contents of cars. Many serious break-in-twos on the road are caused by the damage done to couplers or drawgears while trains are being made up in the yard. Undue urging and unnecessary reprimands might either slow down the movement of the men or produee careless work.

Yard Engine Movement

In operating yards succesfully at a minimum time and cost, the following factors are essential:

1 Droege: Freight Terminals and Trains Chapter 10

1 The disposition of power to the best advantage.

2 A system of checking the engine movement.

3 The knowledge that the engines are kept moving without making false or unnecessary moves.

4 The power and force are kept balanced.

For the economical use of power, careful planning of the movement of the yard engine is necessary. The number of engines employed is the controlling factor in keeping the cost at a minimum consistent with the proper handling of traffic. A regular engine schedule must be maintained and constantly revised for switching engines so that it may be known just where each engine should be and on what work it should be engaged at any particular hour. In planning the schedule, the movement both in and out must be met. The interior movements, including the freight house and transfer work, and the placing of cars on private sidings, in engine house, coal trestle and team yards, all of which must be dovetailed accurately.

With a view to avoid dead-time for yard engine because of the irregular flow of trains in the yard, yard engines may be arranged to work only a portion of the day, and their hours of work must be so arranged as to conform most closely to the periods of the greatest density of traffic. The yardmaster should become familiar with the periodical variation in the amount of traffic and prepare to anticipate the increase and decrease in the movement. The superintendent by keeping in touch with the movement of traffic [illegible] the adjustment

terminals, can also aid in the regulation of the yard engine force.

The engine schedule can be carried out by the use of telegraph or telephone for reporting to the dispatcher the arrival and departure of yard engine at certain selected points. Dispatchers may be assigned at the various reporting stations to keep record of engine movement and check it against the train sheet. They should follow up and demand explanation of apparent detention.

A record board may be used instead of the train sheet. "The board is ruled in squares, with a peg hole in each square. Each yard engine is represented by a peg with the engine number on it. Horizontal lines represent reporting stations; vertical lines half-hour divisions progressing from left to right; there being 48 to represent a 24-hour period. The arrangement is on a general plan of a time chart. As the engines are reported, they are moved to the corresponding peg holes, at the intersection of the horizontal line representing the reporting station and the vertical line representing the nearest half hour division to the time at which the report is received. The peg remains in the hole until the next report of the engine's movement is received. The movement may be copied on a train sheet for permanent and subsequent study by the yardmaster, trainmaster or the Superintendent."[1]

" Power should be very carefully assigned after the schedule

1 Droege: Freight Terminals and Trains P. 111

have been mapped out. Light engines with short wheel bases should be used on curves of short radii or where structures are weak. Heavier power should be placed where tracks, bridges, and curves will permit, and where heavy tractive power can be utilized to advantage." "Worn-out engines may be used, but sometimes it is not economical as (1) it requires just as many men to man, and (2) consumes just as much fuel. Two engines in a yard will usually interfere with each other. Road engines may not be economical in yard service as they are not adopted for quick stopping and starting, and from them signals can not be readily seen. Engines in classification yard should be sufficiently powerful to handle as many cars as road engine brings in and to start them quickly".[1]

Engines running to and from engine house to have fires cleaned, to take coal, water and sand, or to make minor repairs may ensue delay especially when the power is most needed. To remedy this a relief engine may be put in service, manned by a hostler and a helper. It starts out in the morning following a regular schedule in going to one engine taking it back totthe ash-pit while leaving the relief engine for the regular crew to work with, returning the yard engine to its crew and then moving on to relieve the next engines One engine and crew will be dispensed with in this way, but the remaining engines will be in continuous service."[2]

1 & 2 Droege: Freight Terminals and Trains P. 112

The amount of power and force in the yards should be kept perfectly balanced, and adjustments must be made when necessary. As the terminal system is usually divided into sub-yards or districts, each is assigned one or more engines, frequently the same amount of power remains in the district even tho the business is decreased, whereas there is a dire need of assistance in some other districts. Thus it is essential that shifting can be done among the yards. However, as the increasing and decreasing of fixed force must meet the approval of a long channel of higher officials requiring a great length of time the yardmasters often feel reluctant and unenthusiastic about any change.

Yard Congestion---Causes and Remedies.

Yard congestion and delay are the chief source of complaints and loss in revenue. Every measure must be taken to guard against their happening. The yard congestion is generally due to the following causes:[1]

1 " A sudden increase in the amount of traffic destined to or thru a given destination or terminal.

2 " The lack of precaution to assure the prompt loading or unloading and the handling of cars so that they can be gotten out of the way.

3 " The movement into the yard is permitted to continue with-

1 Byers, C.M. Economics of Railway Operation P.540

out interruption until the yard finally comes to a stand-still.

The relief of congestion naturally demands herioc effort. The following measures may be taken to clear the blockade.

1 Attention should first be directed to the inward movement with a view to stopping or reducing it. The incoming freight may be stopped by embargo, by side-tracking, or by other means. The demand and threats of the shippers should never be permitted to influence other action. Switching room is essential inside the yard.

2 Sufficient power and forces must be provided to move out the cars from the yard. Careful canvass should be made of the power. Engines in shops or waiting shop should be inspected, and work concentrated on those that can most promptly restored to service. The method of assigning crews should be studied and revised. Local and other freight locomotives should be thrown into link or pools. Work train service must be reduced or stopped. Road engines in use in yards must be restored to road service. Engine rating should be revised and the engine dispatching facilities inspected and improved. If the delay is due to the lack of power or improper handling of power on a connecting division, that difficulty requires attention.

3 Trains ready for movement must be instantly dispatched and clear the main track. The blockade troubles may be aggravated by permitting the main tracks to be blocked. It has the additional handicap of reducing switching room. No attempt should be made in singling out out preferred or special delivery on request from anybody, this would

only increase confusion.

4 The usual practice in clearing a blockade is to put away cars on any tracks that may be convenient in order to tide over the temporary difficulties without regard for the hereafter. These tracks may be convenient to get into but ~~but~~ hard to get out of. The cars are then overlooked and lost and cause great effort in locating. This makeshift method should not be adopted; orders in procedure should by all means be followed. Keeping a close check on the cars standing last on single end tracks, the cars furthest from the switch on connected end of the track, and not permitting them to stagnate, will ordinarily keep things going.

5 Yardmaster or other officers must retain their composure and control their temper. Little can be expected of men during disturbing times, when they see their leaders get excited.

Efficient Yard Operation.

To relieve yard congestion is none better than to prevent its occurrence. To do this, the yard must be efficiently operated at all times.

1 The inbound trains must be delivered with regularity and outbound trains started as soon as they are ready.

2 The yardmaster should be constantly informed as to road conditions and the chief dispatcher as to the yard conditions so as to hold trains back when they can not be properly handled in the yard.

3 Under conditions of heavy traffic and unfavorable weather

[illegible]

4 Everything must be in readiness at all points. Any failure to have switch list, instructions or other clerical matter ready for conductors going on duty will hold up the work of the entire crew and delay the train.

5 The "consist" or composition of approaching train must be known and communicated in ample time.

6 Delays often ensue because car inspectors do not inspect trains and couple up hose early enough to let trains start on time.

7 Yards must be cleaned immediately after snow storms.

8 Yard office must always be kept in order, such facilities as filing systems, record books, bill racks, telephone and telegraph connections be in function, in order to accelerate the clerical work.

9 The yardmaster must spend most of his time outside to investigate and learn in advance of heavy and unusual [illegible], to prevent being caught in a state of unpreparedness.

10. Changes or improvements must be made in the way of handling with a view to increase efficiency. Close scrutiny of the work at a transfer station, a manufacturing plant, a shop, or other side issue may develop an advantageous change. A consolidation with other work will sometimes make a saving of engine work. A different hour of time may benefit the work.

11 Minor changes and details must be given immediate attention. If more engines are needed or additional men with engines,

that should be quickly put on. The worst delay or difficulty may [illegible] [illegible] trouble in [illegible].

For Yard Congestion and its Elimination refer to
Droege, J. A. Freight Terminals and Trains;
[illegible] Railroad Freight Transportation.

PART II TRAIN OPERATION

Chapter 4 Train Dispatching

Starting a Train
Watching Train Movement
Standard Code of Train Rules
Time Table
Train Order
The Elimination of "31" Train Order
The Elimination of Written Train Order
Policy of Train Operation
    Freight Service Consideration
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Attending On Train
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PART II   TRAIN OPERATION

Chapter 4   Train Dispatching

As the train is made up in the yard, the yard master computes the tonnage, and when the latter equals the rating of the locomotive assigned, he delivers the train to the conductor with the waybills. The conductor compares the waybills with the numbers and initials of the cars and checks the tonnage of the train. Meanwhile, his brakemen couples the engine on the head and the caboose at the rear of the train, tests the airbrakes and examines the doors and seals. The conductor then compares the train orders with those held by the engine crew, enters the time of departure on the station register and gives the signal to start.

When a train starts out on a road, its movement is watched day and night by the operator at every telegraph office, and the time every train passes each station is promptly telegraphed or telephoned to the dispatcher's office, where the clerk enters the time on a record known as the train register. The train register is kept constantly under the observation of the train dispatcher who controls the train in motion and communicates with it from time to time.

On nearly all the railroads of the United States, the movement of trains is conducted under the Standard Code of Train Rules formulated by American Railway Association. The Code consists of rules relating to standard time, time table, signals and their uses, classification of trains, train rules, and train orders and their forms, all

of which must be fully understood by trainmen. In addition, the Code contains a series of definitions for the terms used in railway service

The movements of trains are directed by (1) Time table, (2) train orders, and (3) signals

Time table

Regular trains, or trains moving on schedule, follow the instructions on the time table which specify the times for leaving, passing and arriving, and confer the class and direction on train to indicate superiority. An inferior train must keep out of the way of a superior train. Train of the first class are superior to those of the second; trains of the second class are superior to those of the third, and so on; regular trains are superior to extras (extra trains are not scheduled on time table). The class of the regular trains is determined by the management when the schedule is established. A freight train may be first class, but generally passenger trains are first class, fast freight trains second, and slow freight trains third Regular trains are numbered. Trains in one direction have odd numbers those in the opposite direction have even numbers. Extra trains are designated by the numbers of their engines and the direction in which they are running. On single track, trains in one direction are superior to trains of the same class in opposite direction.

All trains are run on either the Eastern Standard Time or other Standard Times, according to which all the watches of the crews must be adjusted. Each time table supercedes the preceding time table.

Time table schedules are in effect for 12 hours. Regular trains when over 12 hours late, lose their class and right and can proceed only as extras.

A train must not leave its station until it has been ascertained whether all trains due which are superior or of the same class have arrived or left. A section which is one among the trains running on the same schedule, may pass and run ahead of aanther section of the same schedule by exchanging train orders, signals, and numbers. An inferior taain must clear the time of a superior train of the same direction by five minutes. Trains running must keep five minutes apart. At meeting points on single track, inferior trains must clear the main track before the leaving time of the superior train. A train must not arrive at or leave a station in advance of schedule time.

A train may overtake and pass a disabled train, exchange schewidle and train order with the latter, and report to the next available point of communiaation.

Regular train, duly observing the foregoing principles and keeping on time, can make theair ways over the road without assistance.

Train Orders

The movement of extra trains, which is not represented on the time-table, must depend upon train orders. Sometimes the regular trains, when delayed or requiring readjustment of time, must also rely on train orders, The latter confer "rights" on trains, which are supetior both in class and direction, They take the following

forms:

a Fixing meeting point for opposing trains.

b Directing a train to pass and run ahead of another train.

c Giving a train the right over an opposing train.

d Giving regular train the right over a given train.

e Time orders

f For sections

g Extra trains

h Work extras

j Hold orders

k Annulling a schedule or a section

l Annulling an order

m Annulling part of an order

p Superceding an order or part of an order

For double track railroads, two more forms are used, namely:

r Providing for a movement against the current of traffic.

s Providing for the use of a section of double track as single track.

The issuance, transmission, delivery, and execution of train orders must be done with great care in order to prevent errors and misunderstanding. They can only be issued by authority of and over the signature of the train dispatcher. They are transmitted by telegraph and numbered consecutively each day beginning with number one at mid-night. Each order must be given in the same words to all stations or trains addressed, and immediately recorded in full in a book

provided for the purpose at Dispatcher's office, and with it recorded the names of those who have signed for the orders, and time and signal which show when and from what offices the order was repeated and the response transmitted, together with the dispatcher's initials.

There are two classes of train orders. (1) The "31" order, written on yellow paper, is used to restrict the superiority of a train and must be acknowledged by the conductor before it is made complete; a train must stop to receive the order. (2) The "19" order written on green paper, is used for any purpose except to restrict the superiority of trains, and does not require the signature of the conductor before it is made complete: it may be delivered while the train is in motion. The double order system slows up the movement and has of late years been quickened by the free use of the "19" orders handed up to the enginemen and conductors by "hoops".

Train dispatchers must anticipate the necessity of train orders and have them ready for delivery immediately on arrival of the trains. Three dispatchers are assigned to a district, each working an 8-hour trick, so that the service continues day and night. The successful operation of train service depends much upon the skill and judgment of the dispatcher.

The specific requirement of the Standard Code as to the transmission of train orders are as follows:

To transmit a train order, the signal "31" or the signal "19" must be given in each office addressed.

A train order to be sent to two or more offices must be trans-

mitted simultaneously to as many of them as practicable. The several addresses must be in the order of superiority of trains.

Operators receiving train orders must write them in manifold during tramsmission, and if they can not at one writing make the requisite number of copies, must trace others from one of the copie first made. When the "31" order has been transmitted, operators must repeat it at once from the manifold copy in the succession in which the several offices have been addressed, and then write the time of repetition on the order. Each operator receiving the order should observe whether the others repeat correctly.

Those to whom the order is addressed, except enginemen, must read it aloud and then sign it, and the operator will send their signature preceded by the number of the order to the train dispatcher. The response "complete", and the time with the initials of the train dispatcher, will then be given by the train dispatcher. Each operator receiving this response will then write on each copy the word "complete", the time, train dispatcher's initials, his own last name in full, and then deliver a copy to each person addressed except enginemen. The copy for each engineman must be delivered to him personally by the conductor, and the engineman must read it aloud to the conductor before prodeeding.

For time table and train orders refer to

H. R. Hatfield Lecture on Commerce Vol. I PP. 44-50

American Railway Association Standard Code of Train Rules

Pennsylvania Railroad Book of Rules

[illegible] of "19" Order.

[illegible] freight trains, it is necessary to minimize train stopp..Railroads with limited track facilities tend, therefore, to favor the exclusive use of the non-signature "19" form of train order in preference to the "31" form which requires a train to be stopped to secure the signature of the conductor. Especially on single track lines the delay to one train stopping for a "31" order is frequently reflected in further delays to other trains with which it may have meet orders. While the exclusive use of "19" order is mostly favored by the officials, some still embrace the fear that it is not as safe as the "31" order. The Railway Age, in February, 1925, conducted a contest on the use of "19" order as compared with "31" order. Out of the 131 papers submitted by railroad men, the majority favor the use of "19" form basing on the great saving in time, and presenting proofs that with certain limitation it is as safe as the "31". On the other hand, a few opponents, submitted good arguments for the retention of Form "31" under certain conditions. Some roads have developed clearance cards, dispatcher's [illegible] "19" [illegible] trains.

[illegible] increased locomotive miles and decreased

number of locomotives; increased car miles and decreased overtime; increased train haul and decreased fuel consumption; increased number of "on-time" trains and decreased damage of draft rigging.

[illegible]. *Elimination of Written Train Orders.*

Regarding the dispatching of trains by train order, the following remarks have been made by S. Ennes, ex-president of Wheeling and Lake Erie Railroad: "Few people other than those who have had actual experience in moving trains understand or appreciate the intricacy of train rights and the details of advancing trains by train order.

" The securing of superior train, sending the order to all concerned, getting the acknowledgment, repeating it, reading it to the operator by the conductor, carrying it to the engineer, reading it to the conductor by the engineer, arriving at a mutual understanding of their rights and all before it can be acted on.

" When the requirements of trains can be anticipated and the train orders issued in advance, this detail need not delay them, but it is often impossible to tell in advance when a freight train will be ready and in a discouraging number of cases so much time has been consumed getting the order that the train can not make the move and clear some superior train, and the orders must be annulled or torn up and prepared again, repeating the same routine.

" Furthermore, and this does not appear in any record, only the train dispatcher know how often he lets trains lie at sidings because by the time he could get out the order the train could not clear some

[illegible]

" [illegible] these delays are progressi[illegible] [illegible] the traffic. [illegible] [illegible] so rapidly that in many places [illegible] before the traffic justifies the [illegible]"

In [illegible], much has been heard about the elimin[illegible] [illegible] because of the delays to train movements. The Si[illegible] [illegible] American Railway Association has made extensive [illegible] [illegible] by signal indication eliminating train orders. [illegible] convention, this subject has received thorough dis[illegible] [illegible] and concrete incidents [illegible] [illegible] that the latter might turn [illegible]

[illegible]

[illegible]

1 The signals for directing movements of trains may be:

a Green Classification Signals put on by the Yardmaster.

b White Classification Signals put on by dispatcher by train orders.

c Train Order Signals displayed by operators to stop trains for transmitting train orders.

2 Signals for indicating conditions of tracks---tracks which may be physically unfit for use, or occupied by other trains--conditions of switches and trains are as follows: (they serve to indicate to trainmen when to start and stop and when to reduce and increase speed)

a Colored flags, lights, and markers displayed on trains.

b Flags, lights, fusees, and torpedoes used by flagmen for protecting trains.

c Flags and switch targets set by bridge- and section-men.

d Interlocking plants erected at junctions, grade crossings yards, or sidings, which consist of an assemblage of switches, locks, and signals appliances, so constructed that their movements may succeed each other in a predetermined order.

Block system used on consecutive blocks, each of which is a length of track of defined limit, with a fixed signal at the entrance of the block to space the trains and to govern them in entering and using that block, to avoid collision. Block systems are of three kinds.

(1) The Manual Block System consists of a series of block signals operated manually upon information by telegraph, telephone, or other means of communication.

(2) The Control Manual Block System consists of a series of block signals controlled by continuous track circuits, operated manually upon information by telegraph, telephone, or other means of communication and so constructed as to require the co-operation of the signalmen at both ends of the block to display a clear or permissive block signal.

(3) The automatic Block System consists of a series of block signals operated by electric, pneumatic, or other agencies actuated by a train or certain conditions affecting the use of a block.

Policy of Train Operation

The working out of a policy of train operation and of a train schedule is governed by two essentail factors: (1) the nature of service demanded, and (2) the length of haul and the running time involved. Rendering satisfactory service to patrons to cultivate goodwill and maintaining the tonnage thruout the train district without

: Dewsnup, E. R.: Railway Organization and Working P. 196
American Railway Association : Code of Train Rules, Section on Signaling.

[illegible]
serious consideration.

Freight service can be classified in two principal types: the expedited and the non-expedited. The former consists of live stock, perishables, and manufactured goods, requiring quick dispatch, which must go in fast freight trains. The latter consists of the heavy non-perishable products which may go in slow freight trains. The "fast" [illegible] [illegible] it is justified; otherwise it is an expensive luxury, sacrificing tonnage increasing cost and causing delay to slow trains. On the [illegible] [illegible], running one or more trains a day as extras hauling all of the [illegible] which the locomotives will reasonably pull over the division in [illegible]aximum load and at minimum cost, so long as unreasonable delays and [illegible] [illegible] [illegible] ton cost of the items of variable train expense." It is apparently the most economical form of transportation.

Altho good service must always be maintained, yet abuse and wasteful operation should not be permitted under cover of good service. Expedited trains should necessarily be provided for certain particular commodities, but they should be kept down to a minimum. Again, altho it is impossible to expect every class of traffic to

pay its way, yet it is a poor policy to carry a majority of the traf-
fic at a heavy loss. The handling of the expedited trains is a delicate problem. "Several years ago a certain railroad went into the hands of receivers thru continued failure to make its revenues cover its expenses and its interest. Upon examination, it was found that the principal trouble was that the road, which was pretty well dominated by the traffic department, had been making extraordinary efforts to secure and to handle in a highly satisfactory manner such freight as fruit and live stock. Facilities in the way of icing plant and warehouses and commodious and well appointed feed yards had been built. Freight locomotives designed for speed rather than for power had been purchased. Low class freight was not thoroughly solicited nor was it given much attention when offered. From the standpoint of gross revenue, the policy was fine but the most cursory investigation show that the high class freight was not paying its way and that every train of fruit and live stock which moved over the road left a deficit between its revenue and the cost of its handling."[1] It is therefore, essential to analyse closely the cost of handling any class of business which may demand special service, and which will interfere in any way with the operating routine, to see whether it will pay its way. The traffic department must be informed of the non-profit yielding freight which shall be rejected.

To maintain tonnage and still handle trains over the long dis-

1 E. Cordeal : Railroad Operation P.126

[illegible] without the regular payment of overtime and without undue length of time-away present another difficult problem. The relocation of terminals is commonly resorted to, but this entails heavy capital expenses. In establishing the best possible practice without improving facilities, the "turn around" system may be arranged between terminals on long divisions, or a "swing run" may be employed in the middle of the division to expedite movements and reduce overtime with great satisfaction.

Aside from the above mentioned principles, there are minor points which might well be taken into consideration. " On lines of thin traffic, it is customary to place a passenger coach on the local freight train, making the same a "mixed" train, and a similar practice is followed of placing a car of high class or perishable freight on a local passenger train. A 'drop and pick up' train can be run to great advantage. It relieves the local of the carload switching at the stations, distributing all cars, both loaded and empty, billing or moving on orders of the car-distributor, and brings into the terminal cars set off for bad order, or to lighten tonnage to avoid the 16-hour laws and especially cars carrying "fast freight" cards."[1]

Attending on Train

In order to obtain a clear idea of the general ways of attending on train, nothing can be better than to refer to the vivid illustra-

1 Coree, C.J.: Railroad Freight Transportation P.486

tion given by B.C.Burt.

"---suppose that at a junction station a train-load---say twenty five cars--of cattle arrives on one line to be delivered to another and forwarded by it. The train is reported due to arrive at 1:30 a.m. This information is furnished as advance information early in the previous evening. As there is, we will suppose, no night force on duty, at the station, the agent and other station men set their alarm clock for 1 a.m., and are on hand ready to work by the time the train should arrive. The yardmen were up at 12:30 calling crews. Owing to a "slippery rail", a "hot-box", or a "leaky flue", the reported train failed to make time and arrives at 3 a.m. Arrangements are made as expeditiously as possible for receiving the train from the connecting line over the transfer. The engine crew has been called by the roundhouse foreman or some of his men, and engines have been ready and waiting since 1:30 a.m. Train crew and engine crew get together and proceed to remove the train load of cattle from the transfer and get ready for starting, the cars having been inspected before being accepted from the connecting line. While the train is being gotten ready, the agent and his assistants, say the operator (for the agent is not allowed to do the telegraphing and so dispense with the service of the operator for the time being) and the yard clerk, attend to the other matters connected with or necessary to the movement of the train. Agent and the operator "get busy" and make the twenty five waybills which must accompany the stock, or else merely register cer-

their bills from the connecting line and stamp them to indicate time and place of transfer; the yard clerk takes a check of the train, making a correct list of the numbers and initials of the cars in which the stock is to go forward; he also prepares stock contract to be executed by the agent, and the men in charge of the stock jointly. The operator gets into communication with the dispatcher, gives him necessary information as to the nature of the shipment about to move, as to its destination, as to points at which the cattle must feed en route, as to when stock was last loaded, as to the name of the conductor in charge of the train, the number of the engine hauling it, etc. and in turn receives, at the end of a few seconds allowed by the dispatcher to make necessary calculations, a train order directing the movement of the train, which according to our supposition is an extra. While the operator is at work, the agent makes a personal inspection of the general condition of the shipment, converses with the men in charge of the stock, learning their wants and their opinions as to the conditions of the stock, and signs the contract with the men. The conductoe meanwhile gets the poesession of the bills, examines them and compares them with the check he has just made of the train he is to handle, and if he finds no discrepancy, accepts them and registers them in his train book and is then ready for his orders. These he receives from the operator, reads them aloud and signs them, waits for the operator to get the final "O.K." from the dispatcher and prepares meantime the detail or "consist" of his train which the operator

must give by wire, immediately, to the dispatcher. When the orders are finally ready the conductor takes them and, placing the necessary record of his departure on the train register, goes out to his train, gives the engineer a copy of the train order and orders him to "let her go", i.e. open the throttle and begin the run with the stock. If the agent finds that the condition of the stock was not entirely satisfactory, he makes on his record certain memoranda as to its condition, which may be of use should any claim be entered by the shipper for damages. Of course, if the condition of the shipment was too bad he would communicate at once with the dispatcher, informing him of the facts in the case and awaiting advice from him as to its acceptance or non-acceptance from the connecting line. If the shipment was not fit to move forward, the dispatcher would decide not to assume the responsibility of moving it. If when the shipment was received a bad order car were discovered in it, making necessary some repairs or perhaps a transfer of its contents to another car, and consequently a delay, full explanation would have to be made to the dispatcher of all circumstances in the case. Every part of the entire transaction becomes a matter of detailed record for purposes of future investigation in the case of need".[1]

Preference, or fast, freight train dispatching

Preference, or fast, freight trains handle commodities made up

1 S. C. Burt: *Railway Station Service* P. 126

of package freight of an important or of perishable nature, generally moving thru freight house or piers for receipt or delivery; or solid carloads of high class freight usually perishable or inflammable, altho under certain conditions commodities such as cement, lumber and petroleum require fast freight service. since preference trains run on high speed with tonnage load only about 1/3 that of the slow freight trains, and at the same time cause interference and overtime to slow trains and increase liability to accidents, great care is needed in their dispatching. It is desirable to arrange for the smaller number of regular fast freight trains to be run and at sections as required to permit flexibility in train and yard operation. They must be scheduled so that the various train connect with each other permitting freight to be moved over long distances with a minimum delay at any one point.

The following points are essential to the operation and dispatching of preference freight trains:

1 "The speed (about 18 to 20 m.p.h) must be maintained with regularity. The capacity of the engine should be such as to enable it to make the average speed on the maximum grades.

2 "First class engine adopted to high speed with picked crew should be assigned to the run.

3 "The tonnage should be closely watched to avoid overloading and consequently inability to make the necessary time.

4 "Other than authorized commodities must be prevented from moving in fast freight trains.

"The cars must be readily distinguished by placing on their sides marks or card bills of distinctive colors, known as "symbols"

6 "Proper service at division yards should be arranged for gathering and distributing fast freight cars so as to avoid delays to regular fast freight trains and in switching and changing of engines and cars.

7 "The yardmaster should have advanced information of the make-up of the approaching fast freight train and the number and location of the cars to be taken out of the train to enable prompt handling to have cars filled out in readiness.

A "The outgoing cars should be placed at houses or piers in such position that practically the train is made up in book order when loading is completed

B "At intermediate points and division terminals, the train is not usually run into the regular classification yards, [illegible] made up for final destination, it is only necessary to drop the cars for these points and take on those to be added.

C "The cars to be stopped are probably at the head end, and if the engines are changed the incoming engine holds onto these cars and sets them off.

D "Cars to go from the station and must be placed in the proper position in the train, and if this would cause detention, they are usually held for a later or slower train.

8 "Schedules should be worked out and placed in the hands of

all interested in handling, to arrange for picking up high class freight along the division and for delivering freight along the intermediate points with the quickest possible dispatch and without requiring stops.

9 "Clearly understood arrangements must be made with the connecting lines for prompt and complete delivery. Full information should be furnished regarding the requirements of icing, feeding, etc.

10 "Waybills must be forwarded by train mail or U.S. mail or express.

11 "The [illegible] or working book should be placed in the hands of dispatchers, yardmasters, agents, conductors, and others interested, and should give information in detail as to starting time of train, time at intermediate points, how cars are to be taken into train along the line and how cars for various points are to be disposed of, also as to the movement to and from branch and connecting lines and arrangements for advance notice to division ahead."[1]

12 "The Car Record Office must follow up the entire movement of the train. The agent must wire to the office cars ready for movement the yardmaster must report the train leaving his yard. The conductor must wire immediately thru the agent if a car is set off [illegible] and, at the end of his run, must make a complete report of the entire movement. A record must be made up by the car record office from the above reports; attention must be call to any delay and inquiry

1 Droege: Freight Terminals and Trains P.182

instituted until the car resumes its movement.

Following is a description by E.R.Dewsnup of the working of the Red Ball System[1] which will help to present the detail operation of fast freight trains.

About seventy stations have been named as Red Ball billing stations; each being designated by letter or letters, and assigned a series of numbers to be used in numbering the envelopes carrying the waybills for the cars. On each side of every car is attached a card (in size 7 by 9 inches) with a circle filled in with red, on which is set in white the number of the train in which the car is to travel. These cards are of course removed at destination.

A special envelope, also red in color, must accompany each car of Red Ball freight, and every empty car that may be handled as such. The envelope covering the car for the nearest destination is given the opening sysmbol number, and the envelope for each succeeding destination is given succeeding numbers consecutively in the same order. For example, Chicago forwards Red Ball freight on a train as follows: 1 car for Davenport, 2 for Des Moines, 2 for Council Bluff, 2 for Denver, etc. The opening number 1 should be given the car for Davenport 2 for Des Moines and so on, and the opening number of the next envelope for Red Ball freight for Chicago would be 8. The envelope would of course bear the Chicago symbol F.M.

Before the train leaves a Red Ball station, the agent compiles a "consist" report from the information shown on the envelopes and

this report must be wired to the General Superintendent within an houf after the departure of the train. This report gives the symbol number and letter, car number and initial, contents, consignee and destination, and, in case the latter is beyond the company's line, the junction point where the car leaves and the routing beyond.

Each agent at the close of each day, must file with the operator for transmission (forwarding a copy by first passenger train) a report of all Red-Balled cars on hand that were ready to go forward prior to the departure of the Red Ball Train upon which they should have moved. This report, besides car numbers, initials, contents, and destination gives the hour received and the cause of delay; a supplementary report gives the date and train forwarded.

Whenever a loaded Red-balled car is set out, a form known as "Set-out car" is made out and attaches to the face of the red envelope travelling with the car. This form is of a green color and mucilaged for convenience in attaching to the envelope. It is left, with the envelope attached, by the conductor with the telegraph operator at the point where the car is set out, and the information is at once wired to the General Superintendent. If a car is set out at a blind siding, the report will be left at the next telegraph station, and the agent at that point must immediately inform the pooper official. A car that are set out and held for another train must not be held except on account of being in bad order. If the freight is transferred to another car, the necessary information is entered on the red envel-

ope, but no change is permitted in the original symbol number and letter, which must idendify the shipment to its destination.

Reports previously alluded to have provided for complete information in regard to the shipments--i.e. consignee, commodity, etc. but the "set-out car" report provides only for train and car symbols and numbers. This is true also of any new reports hereinafter alluded to, as a car, after once having left the billing point, is known by symbol only.

When a delay car is forwarded, agents or yardmasters advise the General Superintendent by wire, stating the symbol number of the car and the new train number. A report is not required, if a car, set out, is forwarded on the same train and date on which it arrived at a station.

Agents or yardmasters at district terminals and other designated stations must wire the General Superintendent of the passing of trains and cars bearing the Red Ball freight. This report states only the lowest and highest symbol number of the latter on the Red Ball envelope. When a break occurs in a series, two series are used in the report, the first terminating with the number preceding the missing symbol.

A similar report is used in reporting arrival at destination, at junction points, with the exception that freight destined to local and branch line points is followed only to the district terminal or crossline junction point. It then becomes the duty of the Division-

[illegible]
[illegible] destination on the first proper train, and that this arrives at destination as nearly on time as possible.

Red Ball freight at intermediate stations --i.e., stations between district terminals--is forwarded to the first district terminal [illegible] at non-Red Ball billing stations have cars entitled to such billing, wire the agent at the first Red Ball billing station on the route of the car, and upon the arrival at such station, the car is handled in the same manner as is originating at that point. Local merchandise-cars travelling as Red Ball freight are Red Balled to the last district terminal reached before distribution begins. Again, at [illegible] at district terminals are required to scrutinize all waybills, to discover whether or not any shipments are entitled to Red Ball service.

The movement of Red Ball Trains, as has been suggested, is under the direction of the General Superintendent, but such Superintendent is required to notify connecting divisions of the movement of all such trains or cars destined for such divisions. Diversion of loaded cars in transit is handled by freight claim agent, the station agent who makes the diversion wiring the General Superintendent of his district [illegible].

[illegible]

[illegible] the movement of this class of freight, [illegible] is merely on requests for information as to location, [illegible], or [illegible]. All such tracing is handled thru the assistant to the General Vice President. All telegraphic tracing is done by code, the inquiry being made of the General Superintendent most likely to have the car. If he has not seen the car, he passes the inquiry to the General Superintendent to whom it has gone, wording the message in such form as to make it clear who it is that wants the information, and answer is made directly to the person making the initial inquiry

Where the destination of the freight is beyond the company's own rails, delivery to the connection is reported, followed by a report of arrival at the ultimate destination, if desired, by mail. Trains are given a symbol letter, according to their points of origin and the date on which they depart, and are known [illegible] their destination by these symbol letters.

[illegible] System.

With the view of reducing yard switching and terminal work and at the same time expediting the movement, the "[illegible]" system has been developed with satisfaction. A "[illegible]" is a train, either expedited or slow, dispatched from a terminal for continuous movement to destination or to a break-up yard, passing thru one or more intermediate yards or terminals intact. It is principally [illegible] by hold-ing cars to make up straight loads to a destination, so long as the terminal delay will equal or not greatly exceed the delay [illegible]

[illegible] along the route.

" The system as being extensively employed by the Baltimore and Ohio [illegible] The Division and Through Classifica- [illegible] [illegible] the system. This book is indexed for quick reference to the com- [illegible]ition of any train and is divided into two sections, the forward- [illegible] [illegible] [illegible]ted to eastward freight train movements. The principle on which [illegible] classification is based is the movement of trains with a minimum of [illegible]reak-up between origin and destination, such switchings as is [illegible]ary being concentrated at the point where this can be most econo- [illegible]lly and effectively performed. This classification is based on a [illegible]gh study of the physical characteristics of the railroad and a [illegible]l analysis of yard conditions and costs at all points. The aim [illegible]n to classify trains completely as near their origin as possi- [illegible]o they can be run solidly through the succeeding terminals to [illegible]tination without subsequent break-up. The advantages of this sys- [illegible] are increased car-miles per car day, decreased locomotives per [illegible], and decreases in per diem, overtime, and yard delays and reduction of [illegible]".

[illegible]

Telegraph and Telephone.

Telegraphy and telephony are used by the train dispatchers and operators for the following purposes in train operation:

1 Collecting information in regard to and in distributing bulletins,

2 Communicating weather reports,

3 Transmitting conductors' reports to dispatchers and other officers regarding the movements along the line.

4 Issuing of special instructions or train orders by the dispatchers to train crews.

5 Communicating general messages regarding traffic matters, such as classification, rates, routing, etc., and tracing shipments.

6 Daily reports of all kinds;

Operators' reports of train arrival and departure,

Car records by car clerk;

Reports of bad order cars;

Reports of cars loaded,

Conductors' "consist" of trains,

Reports of "coded" cars (fast freight),

Train orders and train order signals,

Fuel reports, etc.

To prevent delay in transmission, it is important that continuous attention must be given to the kind and quantity of matters which are put upon the wire. The messages must be reduced to [illegible]

[illegible]

censorship of messages may be employed to advantages.

Much of the operators' time is wasted in calling main and relay offices and waiting for an opportunity to get messages thru. A better system can be brought about by assigning one operator as a "central", receiving all calls from way stations. If possible, the call is immediately switched to the proper operator, but if it can not be instantly handled, the sending operator is asked to call again at a given time, thus relieving the latter from sitting at the key and calling repeatedly until the call is answered.

On many roads, telephone systems have been installed to relieve the telegraph wires of mush of the inter-department and inter-station communication. On the Philadelphia Terminal Division of the Pennsylvania Railroad, train movements inside the Division are conducted entirely by telephone. It has the advantage of rapid transmission of orders and messages, and, since no code is employed, the time for training operators to familiarize with the technique in sending and receiving is totally eliminated. However, according to the opinion of Mr.B.E.Brook, Division Operator of the Philadelphia Division, little time has actually been saved by this system, because oftentimes the operators hang on the phones and chat to their hearts' content.

A long distance telephone system, independent of the dispatching wires would facilitate rapid communication between divisions.

Cordeal: Railway Operation Ch.8; Burt: Railway Station Service Ch.3

Dispatching trains without wire service.

Dispatching trains in heavy storm, after all wire communication is wiped out, keeping the lines open and trains moving with short delays and without accidents, requires exceptional ability. It may be of interest and contribute to knowledge of train operation to cite here the ingenuity shown by the Middle-western roads in overcoming great handicaps during a sleet storm in December, 1924.

"The sleet storm destroyed virtually all the telegraph, telephone and electric light wires, together with the poles which held them. The railways were confronted with the problem of operating their trains entirely without telegraph train orders. The problem was met on the Springfield Division of the Illinois Central by handling trains entirely on time-table rights. Train dispatchers were started from headquarters on the first available trains to establish temporary headquarters at the first point where they found communication possible. Trainmasters and traveling engineers also went on the first trains, establishing temporary headquarters at the different intermediate terminals on the division. By sending orders, instructions and other communications to southbound trains on regularly scheduled northbound trains, it was possible to operate passenger trains on a considerably delayed schedule during the first hour of the storm. The loss of telephone and telegraph wires was not the only difficulty experienced since all of the color light and semaphore signals, together with the interlocking plants, were completely out of service. The storm was

weathered on the Springfield Division without a train accident or personal injury of any sort.

"On the Illinois Division of the Illinois Central the same plan was followed--as many repair gangs were placed on the lines as possible with orders to restore wire for telegraphing immediately, leaving the signal wire as well as the other telephone wires for later repair. The trains were moved on a single track line between Gilman and Clinton under flag protection, flagmen and officers going ahead on motorcars. On this Division, after the line had been cleared of trains which had been longest delayed, a train order was put into effect at Clinton reversing the right of northbound first class trains giving the southbound train right of track for a period of 36 hours. This was done to permit the southbound trains to leave Gilman on time, allowing the northbound trains to move against their schedules without train order. Northbound trains were being more or less delayed on the St. Louis Terminal and Springfield Divisions so that it was not possible for them to leave Clinton on their scheduled departing time anyway. After this was done, little difficulty was experienced in moving trains over the single track territory and by 4 p.m. the next day, train service was practically re-established, notwithstanding the fact that no communication had then been opened up.

"On the Wisconsin Division of the Illinois Central the first move was to obtain an accurate check of wire and line condition. Dispatchers covered the entire distance on passenger trains, making reports to division headquarters, by mail to the first open office

where they were forwarded by wire. Arrangements were then made to run trains on schedules, filling each schedule on time table with at least one section. With dispatchers distributed over the territory, in which no wires were available, train orders were sent by passenger trains to opposing inferior class trains.

"The Burlington was hit most severely in the territory between St. Louis, Mo., and Hannibal. On this line ten regular passenger trains in each direction and eight regular freight trains are operated daily. Under time-table rules north trains are superior by direction to trains in the same class southbound so that the opportunity to move southbound trains depended upon the regularity of adherence to schedule of those going in the opposite direction. The problem was most severe at St. Louis where departing train schedules were so close together at various times during the day that any delay to an outbound train would set its schedule close to or behind the schedule of the following train, so that the southbound trains which were waiting at meeting points might find a northbound train so late on its own schedule that when is did arrive the southbound train would still be unable to move on account of the close following northbound train. The practice of operating the double track line between St. Louis and Machens without orders was followed successfully altho trains were delayed somewhat by reason of the automatic signals being out of service thru freezing. However, the automatic signals of the light type between Louisiana and Hannibal, altho without power for

[illegible], gave excellent service on their storage batteries. The southbound trains used various means of flagging against opposing trains, principally by section foremen or signal maintainers carrying flagmen on motor-cars at a safe distance in advance of their trains. In some cases where a highway was free of trees, wires and poles and parallel to railroad tracks, flagmen were carried ahead by automobiles during daylight hours. The Burlington was particularly successful in anticipating closely the probable departure of the northbound trains from the St. Louis terminal which was badly congested, and in using an officer to ride one train and leave written instructions with opera- tors at Machens and points north to hold following trains until a cer- tain time, continuing north until he found an opposing train, allow- ing it a certain time. This really amounted to dispatching by train rather than by wire.

"One of the officers would leave St.Louis on the 2:15 p.m. train and after checking the situation, and securing the best information as to when the 7:20 p.m., 9 p.m. and 11:55 p.m. trains would probably de- part, leaving time orders with the operators at the end of the double track to hold these trains until a certain time. He would continue north until the four afternoon inbound trains were found, delivering instructions to the first three and accompanying the fourth train back to the double track where all trains were free to move. Freight move- ment was completely discontinued during the first 24 hours following the storm after which the usual number of freight trains, averaging two each way was run.

"Constant running records were kept on the arrival, departure, and location of all trains being operated. Dead freight had to be tied up but live stock was picked up wherever found along the line and run into the terminal in extra trains dispatched as second and third sections of passenger trains".[1]

Peg System

A satisfactory accomplishment in dispatching and moving freight trains with minimum delay and simplified process is found in the use of the "peg system". A "peg" is a non-time-table-schedule for a freight train: The peg system is the provision of pegs for all freight trains. It has been successfully practised on the Buffalo Rochester and Pittsburgh Railroad.

"Before the system was installed, the officers of the company made schedules or pegs, sufficient to handle existing business. These pegs contemplated the best possible performance, barring accident, if all employes and all departments entering into train movement exerted their best effort in this direction. For example, officers were stationed at water towers to time engines taking water. Under their surveillance the employes speeded up the operation as much as possible and it was this performance which was allowed for in the peg. If any crew uses more time in taking water than experience shown to be necessary, a satisfactory explanation must be made. In making observation

1 Railway Age Vol. 78 #6 Feb. 7, 1925.

Before making the peg system, the officers found that switching movements at one point were holding up practically all their freight train. With the publication of pegs, however, these delays were reduced to a minimum, since it was the duty of the switching crew to clear the time of these pegs almost the same as the regular scheduled movements.

"The peg system has greatly simplified the work of the roundhouse forces because they know when they are going to be called upon to deliver the locomotives. Dispatchers are able to arrange meeting and passing points on a definite basis and are required to keep watch on irregularities only, instead of on every movement of every freight train on the road, as is necessary under the system of running all freight trains as extras whenever tonnage, power and crews are available. Yardmasters can not send freight trains out in bunches whenever tonnage, power and crews are available, thus making the trains assume their correct space interval out on the line and consuming more road time than necessary. Train crews, also, know from the pegs assigned to their runs just what is expected of them. No delay reports are required even where delays are met with unless the peg time is exceeded. On the other hand, if the peg time is exceeded, the train crew must present satisfactory for all time lost".[1]

Train Delays and Road Capacity.

Smooth and prompt movement is the primary requirement of train dispatching. Poor judgment, slow thinking, and insufficient atten-

1 Railway Age March 17, 1923.

[illegible] given to the supervision of train movements so as to [illegible] trains, and to hold inferior trains at meeting points for hours, are inadvisable.

Train delays. Train delays accumulate overtime and [illegible] charges, increase fuel consumption, and cause shortage of equipment; what is worse, their repeated occurrence cause the crews to lose interest in trying the get over the line. Generally, train delays may be due to the following causes:

1 Terminal delays including waiting for engines and crews.

2 Defective equipment and roadway.

3 Engine failure, leaking, or poor steaming.

4 Waiting for orders.

5 Meeting and passing trains.

6 Held by block.

7 Taking coal and water.

8 Overloading.

9 Road obstruction and waiting for connection.

Aside from the mechanical defects, all delays can be prevented thru proper attention and supervision. A definite and accurate plan of procedure must be worked out before sending trains out of terminals The common error is to rush more trains out of terminals than the line can handle with the consequence that sidings are blocked. The tonnage rating should be constantly watched and readjusted if necessary. Knowledge of the following is requisite: the quantity and kind of traffic to be moved to-day, to-morrow and the next day; the amount of equip-

seat available; the capacity of lines and yards to accommodate the trains; the conditions in the adjacent divisions and connecting lines, the condition of engines and the weather conditions. Throughout storms reports should be obtained from the nearest signal station, and the detailed daily mail reports and the frequent brief telegraphic advices. Weather reports by wire must also be obtained from designated railroad telegraph stations along the line at stated times and during threatened storms at additional times. Close watching of these reports will often keep the road open. A train should never be permitted to become stalled in a snow storm. If necessary, equipment should be tied up in any stations during severe storms. Finally, it is important that the round houses must be kept fully advised in advance regarding demands for power.

Stopping and starting trains. It is very expensive to stop and start a freight train. The Interstate Commerce Commission operating statistics of large railroads for February 1931 place the average cost of freight train operation by selected accounts at $2.11 per mile and deduces from this that a cost of $5.39 is set for each unnecessary freight train stop. A good dispatching should keep train stops down to a minimum.

Wreck train. The wreck train and its crew which generally consists of car repairers, mechanics, and laborers, should always be kept at hand. Buzzers may be installed in their bed-rooms and actuated at night over a wire circuit by the train dispatcher. In case of wreck, it is required first to report the established line

[illegible] for clearing the track [illegible] cars, the freight trains for terminal yards should not be dispatched until the track is restored.[1]

Detour. Under the standard detour contract, the foreign company (the company using the detour) must provide crews familiar with the Standard Code, must use the pilot furnished by the "home" company, and be subject to all the rules and regulations of the home company and the orders of the train dispatchers.

"There should be kept in the office of the chief dispatcher and trainmaster, carefully prepared charts showing all the detour lines available for each operating division of the road with information as may be necessary as to the grades, curves, strength of building, clearances, etc., which may be immediately consulted should occasion arise".[2]

Use of Sand. "Sand judiciously used will tend to prevent the slipping by increasing the adhesion, but it will also cause the train to draw harder. The ideal condition would be a sandy rail for [illegible] drivers to pass over and a wet clean rail for all the following wheels of the train. This condition would be approximated by a pneumatic [illegible] or a sweeper behind the last driver to clean the sand off the rail."

Cleaning car doors. All car doors must be kept clean. [illegible]

1 & 2 [illegible]: Railroad Freight Transportation P. [illegible] and P. [illegible]

may cause considerable damage to property. Serious personal injuries have been inflicted on people [illegible] standing along passing trains where freight car doors swept the sides of passenger trains. Also, the sparks from the engine may [illegible] inside the car and set it on fire. Furthermore, there is more air and wind resistance in the train of cars, [illegible] with open doors. Lastly, we mentioned that tramps will readily board trains containing cars with open doors.[1]

1 Droege: Freight Terminals and Trains p. 157 and 172

Chapter 5 Train Performance---Tonnage

- Tonnage Rating
  - Rating by Cars
  - Rating by Tonnage
- Restrictive Factors in Rating
  - Condition of Engine and Crews
  - Condition of Track
  - Weather Conditions and Winds
  - Density of Traffic and Passing Facilities
  - Coal Condition
  - Night Movements
  - Acceleration
  - Proper handling and Lubrication
  - Light and Empty Mileage
  - Running Time
- Methods of Increasing Train Load
  - "[illegible]"
  - Doubling the Grade
  - Double Header
  - Transfer of Tonnage
- Improving Tonnage Performance.

Chapter 5 Train Performance---Tonnage

There are many items of operation in which improvement [illegible] [illegible]ance and reduction of expense may be effected, but train tonnage [illegible] essential factor. Since "expenses are by the train mile, re[illegible]e by the ton mile", every added ton to train load means a direct re[illegible]ction in operating ratio and a greater dispersion between revenue [illegible] expense. Inasmuch as the railroad business is one of increasing [illegible], increase in load does not bring about a corresponding in[illegible] [illegible] [illegible] not yet been reached.

[illegible] Rating

The loading or hauling capacity of different classes of power [illegible] each section of the line can be ascertained from the locomotive [illegible]g table prepared by the Motive Power Department. There are gen[illegible]lly two kind of rating, rating by cars, and rating by tonnage.[1]

Rating by cars. "Some roads, as a matter of convenience, or [illegible]use of peculiar local conditions, continue to load their road en[illegible]s according to the number of loaded cars. from which the loading

1 [illegible]

[illegible] method because the numbers of loads in train vary widely. A record kept by one trunk line of a large number of freight trains showed [illegible] capacity, loaded to 10% in excess of the marked capacity.

Rating by tonnage. This rating can be obtained by dividing the tractive power of an engine by the train resistances, (resistances [illegible] of rolling resistance, journal friction, [illegible], and resistance due to curves) which are ascertained from dynamometer test and confirmed by service tests.

However, effective tonnage rating is by no means a simple engineering matter. That procedure is but a preliminary detail, There are many factors that enter into consideration in order to accomplish the desired results and these require insistant and incessant supervision, instruction, and follow-up. Moving trains out of the terminal [illegible] relying on the theoretical rating would easily bring about either one of the following results: the actual performance falling [illegible]

[illegible]

From the stand point of effective operation, the ideal freight [illegible]

lasted and heavily railed track, at normal temperature and in clear and dry weather. This ideal can hardly be realized except on roads handling nothing but coal and ore or similar heavy material. Generally speaking, 100% tonnage loading is not a practical possibility, because of the number of restricting factors such as follows:

1 Condition of the engine and crew. No railroad can keep all of the power at all times in perfect condition, and less unit must be favored.

2 Condition of track.. The efficiency of the application of the tractive power is dependent upon the adhesion of the wheel to the rail. The adhesion is diminished by the poor condition of the track such as small, light rail, with ties spaced at considerable length and ballast of such a nature as to permit the ties to move and sink. Again the coefficient of friction of a rail is materially reduced on wet, frosty or greasy track. The coefficient may be restored by the evenly distribution of sand on rail, but this falls short by 25%.

3 Weather condition and winds. Low temperature increases the radiation from the boiler, cylinders, etc., and reduces the affective steam power. Snow increases the flange resistance. Thus tonnage must be considerably reduced (generally 10% or more) in bad weather, in order to get the train over the division within a reasonable time. Severe weather may warrant the tying up of equipment at way stations. The head and side winds produce resistance on fast freight trains, this also affects the tonnage rating.

4 Density of traffic and passing facilities. On roads with

dense traffic and limited passing sidings, a light train for high speed is necessitated in order to facilitate movement and avoid delay.

5 Fuel condition. Poor grade of coal produces less steam pressure, hence diminished draw-bar pull.

6 Night movements. Movements at night are necessarily less efficient than in day time; the hand signals are more difficult to interpret; telegraph and telephone office less frequent; the crew less energetic.

7. Acceleration. Initial resistance (about 20lbs. per ton weight of train) is required to start a train. When frequent stops ar are made at stations on grade, enough power must be reserved to overcome resistance.

8 Proper handling and lubricating. Improper handling of locomotives by enginemen, such as on the reverse gear and throttle, would diminish the adhesion on rails; neglected and improper lubrication produces friction in car journals.

9 Light and empty mileage. Unless tonnage is perfectly balanced in both directions, (which is hardly possible), there must be a light train or lone engine mileage in the direction opposite the volume. While tonnage in the direction opposite the volume should pay its own way, any traffic which does not require special equipment in handling can be profitably carried in the direction opposite the volume. It helps to carry the expense of moving light and empty cars back for loads, and should be handled to advantage. Sometimes the empty cars, home or foreign, must be returned in due time, thus load-

[illegible]
in the rating.

10 Running time. Altho higher speed means greater tractive power and lower tonnage rating, sometimes there are economic reasons for faster freight trains. Live stock, perishables and high priced commodities such as silk require rapid transit. On lines with dense passenger traffic, lighter loaded freight trains may move at higher speed with fewer passing points, and with a saving in time at sidings on the road. This again restricts the theoretical rating.

Methods of Increasing Train Load

As the tonnage rating is primarily limited by the resistance due to grade, there are, however, several ways to overcome this handicap.

1 The use of "Pushers." "Where there is an exceptional gradient in excess of the ruling grade, the use of "pushers" will increase the average train load on a division. The pusher should be able to haul [illegible] load grade, and its tractive power should be limited to the exceptional grade resistance to be overcome; any excessive tractive power will only incur unnecessary expense.

2 Double the grade. "Where the freight trains are not sufficiently frequent to keep a pusher profitably employed, resort is had to "double the grade", However, there is a danger in that the detached part of the train may be an obstruction to the traffic and be exposed to accidents.

3 Double headers. "On single track line, where trains are concentrated on certain division, these trains may be consolidated and drawn by two locomotives with expedition. On double tracks operated under block signals, double headers may also be used to reduce the number of trains in blocked sections and to expedite the movements.

4 Transfer of tonnage. "At intermediate junctions on a division, the transfer of tonnage may be provided for with economy by a judicious distribution of loaded cars among the thru trains in accordance with the rate of ruling grades. Loaded cars may be hauled by a lighter locomotive to a junction and by a heavier locomotive thereon.[1]

Increasing Tonnage Performance.

The tonnage problem resolves itself into a proposition of so arranging the loading of locomotives as to give them the maximum trains which can be handled over the existing district within the time limit. Loading trains to a point where they are perpetually overrunning the time limit would cause delay and overtime charges; on the other hand, cutting down tonnage to permit of faster movement would increase cost per mile.

The method of improving the tonnage performance lies in accurate rating, followed by constant checking and supervision. Careful service tests may be given and observations made on every locomotive in each section to ascertain its rating. The train loads must be checked up from the train loading reports by the operating officials. "On many

1 Haines, H.S.: Efficient Railway Operation P. 359

roads, the tonnage performance is followed by means of comprehensive reports covering the fuel records of individual locomotives. In such event, the fuel department handled the details of clerical work in connection with the compilation of tonnage figures, and is frequently assigned the duty of calling any case below standard performance to the attention of the proper operating officials".[1] Generally, the dispatchers are required to make the train sheet in duplicate so that one copy may go direct to the general manager's office where all the details of train operation would be constantly supervised. Graphic presentation may be made from the daily telegraphic reports indicating the average performance per train of all tonnage trains forwarded during the previous 24 hours period. From this graph, freight locomotive efficiency may be ascertained, showing the percentage of relationship between the rating tonnage and the actual tons forwarded from each terminal. The difference in tractive effort of power used is weighed. The wheelage and tonnage reports of the conductors may be inspected to ascertain the relationship between the tonnage rated and actual tonnage, any failure to meet the standard must be called upon for an explanation. The loading of engines to their rated capacities and the maintaining of full tonnage standard must be made a habit with the division officers and employes.

In case the cars in a thru train fall by the wayside because of hot journals, broken trucks, or other car disabilities, where these cars can not be ready to go forward in the same train without undue

1 Cordeal, E.: Railway Operation P. 183

[illegible] arrangements should be made to forward other cars for the same destination in their places. In the absence of such cars, those for the divisional terminal may be added, to enable the full tonnage rating to be maintained, unless the direction is that of light traffic.

Attention must also be called to the fact that it is not practicable to reduce the train load to avoid overtime, because of the increased cost incident to the operation of the necessary additional trains in the direction of heavy traffic to handle the same tonnage as in the direction of light traffic to balance power.

Chapter 8 Traffic Capacity

Effect of Speed of Trains upon the Cost of Transportation

Effect of Stopping and Starting Trains upon the Cost and Time of Transportation

Operating Trains against the Current of Traffic

Through Routing of Solid Trains

Increasing Traffic Capacity by Installing Automatic Block Signals

Means of Increasing Traffic Capacity with the Existing Facilities.

Effect of Speed of Train upon the Cost of Transporting Freight

The Committee on Economics of Railway Operation of American Railway Engineering Association has made a study of the effect of speed of train upon the cost of transporting freight and has come to the following conclusions:[1]

1 The effect of speed on transportation cost per ton mile depends upon circumstances of traffic density and physical characteristics of the district considered, viz.,ruling grade, length of district, rise and fall,and curvature.

2 In general, the cost of transportation per gross ton mile or per net ton mile increases whenever the speed of operation is increased by reducing the tonnage rating below the maximum practical rating.

As to the traffic density, three cases arise, each of which must have special consideration.

(1) When the traffic at hand to be hauled is less than the capacity of the line and equipment available. The objective in this case will be to haul freight on "drag" principle, at such a speed that the total cost of transportation is a minimum per net ton mile, provided there exists no special urge for expediting movement. An increase in speed resulting from reduced tonnage rating causes and increase in the cost of transportation per gross ton mile.

(2) When the traffic at hand to be hauled exceeds the capacity of

1 American Railway Engineering Association Proceedings 1926

the rolling stock. If there is a shortage of motive power, the transportation capacity of available motive power can be increased by loading to secure the maximum mileage per hour which will mean increasing speed with decreased tonnage. This prodedure is feasible within the range of normal operating speed. If a car shortage exists some economy of haulage might be sacrificed in order to secure greater efficiency of the cars available thru increased speed--car efficiency increases with the speed, but not directly because of terminal and other delays.

(3) When the traffic capacity at low speed is exceeded by the available traffic. The rating and speed of train might be varied frequently in order to permit trains to make their meeting points promptly and thus minimize delays. The speed that will give the maximum capacity to the track will depend upon the density of traffic.

The effects of speed upon the cost of transportation are manifested in the following:

Maintenance of way and structure---The exact effect of increased speed when accompanied by increased rating and a correspondingly [illegible]-fer engine mileage will depend upon the ratio between engine tonnage and freight car tonnage over the division under the normal operation. If the locomotive constitutes about 10% of the total tonnage in a train, an increase in speed that would increase the number of trains 15% might be expected to increase the M. of W. & S. expense allocable to the traffic involved about 1.0%.

Maintenance of equipment--Locomotive maintenance varies largely

with the mileage [illegible], increased speed will result in an increase in engine mileage. Since locomotive repairs constitute about 1/4 of all the expenses affected by the speed of operation, this item is of considerable importance. The effect on maintenance of freight cars is probably negligible, since the car mileage is not changed by such increase in speed.

Dispatching Trains---A small increase in the number of trains would require the continuous attendance of operators at small way stations, where with fewer trains, attendance for only part time is sufficient.

Fuel, water, and lubricants for road locomotives-- This expense would be increased with an increase in speed.

Road trainmen-- Increasing speed of operation has a varied effect on crew wages, depending upon the physical and operating characteristics of the division involved. Train delays seem to bear no definite relation to tonnage rating or speed. Fuel and train wages constitute 60-70% of all direct train expense.

Fixed charges-- Where the capacity of available rolling stock is exceeded by the traffic, fixed charges may be a factor. If this condition should be permanent, economy would doubtless require the procuring of additional rolling stock. When the condition is temporary or abnormal, with the balancing of higher expense resulting from increased speed of operation to produce greater capacity against the fixed charges, an additional rolling stock would be a necessary consideration.

Transportation efficiency-- The transportation efficiency in ton miles increases with the speed within the ordinary range of speed reaching a maximum and then decreasing. Theoretically, the maximum transporting capacity of available rolling stock would result with a rating of locomotive to secure maximum ton miles per train hour. However, this theoretical result would be tempered by interference from additional trains required to transport a given amount of freight and by the fact that locomotives are not actually on the road more than about 1/3 of the time and freight cars are not on the road more than perhaps 5% of the time. Only under the condition of traffic congestion, when business is lost to the road by lack of handling capacity, is loading to secure the maximum ton mileage per hour instead of per train mile generally justified. In such cases the loss due to greater cost per ton mile will be balanced against loss due to loss of business. In such cases the most economical rating will lie between the maximum tonnage rating and the maximum capacity rating owing to interference of additional trains required to transport a given tonnage.

Effect of Stopping and Starting Trains on Cost and Time

To reduce delays, economize on fuel and reduce the liabilities of pulling out draw-bars, there must be a reduction of train stops to a minimum. The cost of train stop varies with the train load, the speed and the grades, but various tests and reports fix the average cost of a freight train stop at between \$5 and \$6. The train stops

occasioned when entering and leaving a siding are under many circumstances causing cumulative delays that restrict the capacity of the division. The question arises why the stops ordinarily required to permit the switches to be opened and closed when entering and leaving a passing track, cannot be eliminated.

Many roads have installed power switch machines for this purpose controlled from the nearest telegraph office. One road has five such installations in service, one of which is eight miles from the control point. Reports from various roads having a total of nearly 100 such installations in service show an average saving that represents from 25 to 100 per cent. on the investment.

Observations were made by the Committee on Economics of Railway Operation of A.R.E.A. on a number of thru tonnage freight runs for determining the direct cost and time lost on account of stopping and starting trains. The records of these observations were grouped according to one type of power, tonnage handled and weather conditions. The largest group, containing nine observations of full tonnage Mallet trains and eight observations of light tonnage Mallet trains appeared to be the most satisfactory for developing the solution to this problem.

Operation of Trains against the Current of Traffic.

The operation of trains against the current of traffic on multiple track lines implies the diversion of train to a track which is normally used for movements in the opposite direction but which is temporarily idle, thereby avoiding delay to these or to other trains and expediting their movement thereby. It is, therefore, a step in the more intensive utilization of a property, avoiding or postponing the expenditure of funds for additional facilities and for additional side or passing tracks otherwise made necessary by delays to trains.

In some instances where the traffic is uniformly heavier in one direction between hours and then in the other direction for other periods, as in the suburban zones, the direction of traffic on one or more tracks may be reversed by standing time-table order to meet the condition. Thus, a third track is frequently used regularly for inbound trains in the morning and outbound in the evening. This, because of its regularity, does not produce interference to operation. That which requires consideration is the diversion of trains against the current of traffic at will and without advanced warning or notice in order to meet conditions as they may arise at any time thruout the day.

The objection to this system are as follows:

1 It is claimed that after train crews and other employes have become accustomed to the operation of train in one direction only on a track, the running of trains in the other direction introduces a special hazard. In reply, it may be said that while this objection

1 A.R.E.A. Proceedings 1925.

may be valid for a short time following the [illegible] this practice, it is merely a result of habit and [illegible]. The actual operation of trains against the current of traffic is identical with that prevailing on a single track railway, the [illegible] railway of this country, and the hazard should be no greater. Furthermore, no road hesitates to operate trains against the current of traffic in emergencies, and such operation as a customary practice really lessens the hazard attendant upon such operation in case of emergency.

2 That it leads to the introduction of facing point switches in main tracks. This may or may not be true, for the operation of trains against the current of traffic reduces the necessity of additional passing tracks and switches therefor. Furthermore, the same hazard exists at every switch on a single track main line. Frequent use of these crossover switches also leads to the maintenance to higher standards than for normal operation in one direction.

3 That it introduces hazard for trackmen and other employes on track. This is not valid, for while hazard may be introduced when this practice is resorted to only in emergency, when it becomes usual the danger can be overcome by the exercise of proper precautions.

4 That it requires additional investment if the maximum advantage is to be obtained. This is not necessarily true, for trains may be reversed over the existing crossovers. After this, added investment can be regulated by the demands, as is illustrated by the practice on the Burlington and the Big Four of lining up crossovers for

reverse movement by hand at many points, adding interlocking points only where the traffic warrants and affording complete automatic signal protection for reverse as well as direct movement on lines of still greater density of traffic. Where the number of movements to be made against the current is small, the investment can be confined to facing point crossovers or trains can be backed thru existing trailing crossovers. Beyond that point, it should be increased only as an adequate return can be earned.

The advantages of this system are:

1 That it keeps trains moving, thereby reducing delays and the overtime resulting therefrom and in many cases eliminates the necessity for tying up trains in compliance with the 16-hour law. The elimination of stops also reduces the number of drawbars pulled out, etc.

2 That it increases the utilization of locomotives and cars, facilitating their movement over the road, thereby increasing the miles per car day, reducing per diem, etc.

3 That it increases the capacity of a line by enabling more trains to be moved, thereby postponing the necessity of making considerable expenditure for additional main tracks to handle a given volume of traffic without excessive delays.

4 That it reduces the necessity for passing track facilities to a minimum.

5 That it facilitates the conduct of heavy maintenance operations such as the laying of steel and reballasting, by facilitating the diversion of all traffic from the main track on which such work

[illegible] track as a single track during the working day. [illegible] from regular traffic.

After a [illegible] of the problem, the Committee on Economics of Railway Operation [illegible] following conclusion; [illegible] Railway Engineering [illegible]

"Where the volume and distribution of traffic on the multiple track lines are [illegible] delays to trains sufficiently serious [illegible] the consideration of means of effecting relief, the operation of trains [illegible] cost of additional facilities [illegible] relief."

Through Routing of Solid Trains

After a long study of the feasibility and economy of through routing of solid trains and the effect upon the capacity of terminals the following suggestions were finally adopted in the Manual of the American Railway Engineering Association:[1]

(1) The collection of cars into groups with the same or similar destination for movement intact thru intermediate terminals to destination is practical and will increase the number of cars which can be handled thru terminals and reduce the cost chargeable to terminal operation.

(2) Classification should be made according to a systematic plan based on a thorough survey of the origin and destination of all cars, loaded and empty, and of all classification facilities available. The plan should comprehensive in scope and cover all cars handled.

(3) The plan should provide for the assembling of cars for the same destination into groups as early in their movement as possible.

(4) To insure maximum success and minimum interference with the plan, all delays to cars after being assembled into groups should be reduced to the minimum by the removal of the causes for these delays prior to their grouping. This should include good arrangements for car inspection and repair so as to obviate the necessity for setting out cars in [illegible] short of their destination except in the result of an accident.

(5) [illegible] of the plan should be [illegible]

1 A.R.E.A. Proceedings [illegible]

officer with the knowledge of requirements of the system and with an ability to enforce discipline in its place.

Increasing Traffic Capacity by Installing Automatic Signals.

The Committee on Economics of Railway Operation of American Railway Engineering Association has made a study of the effect of installing automatic signals on the traffic capacity and has obtained the following results:[1]

The factors which brought about the increase in capacity and reduction in road time after the signals were installed were as follows:

1 Elimination of the 10-min. rule and substituting a much shorter time due to automatic signals.

2 Possible better movement under the new system in yard limit territory, even thoo the same yard limit rule is still effective.

3 The elimination of "31" orders and the substitution to some extent of "19" orders (which under automatic signal protection is ample) the increase in "19" orders not being proportional to the decrease in "31" orders due to better operation, keeping trains moving and obtaining better meets.

4 The improvement in road time of local freight, as under the automatic block system and telephones they can get the information relative to movements of other trains, and can take advantage of it.

5 Assistance to dispatcher in putting out orders, as they are enabled under the new installation to get more information as to location and movement of trains.

6 [illegible]

The installation of automatic block signals on a single track railroad has the following advantages:

1 Increase the track capacity, resulting in a saving in road time on through traffic.

2 Increased safety.

3 Increase in the capacity of the train dispatcher, including his ability to handle better, due to cutting the number of train orders in half.

4 Reduction in damage to loading of cars due to the elimination of freight train stops.

5 Reduction in the number of engines and cars to handle the same business in the same time.

6 Increased goodwill of shippers because of more speedy delivery.

Means of Increasing Traffic Capacity of railroad with its Existing Facilities.

As we have realized in the introduction that increasing operating efficiency or traffic capacity by adding new equipment may be physically impossible or financially prohibitive, we are here primarily interested in the improvement of operation with the existing facilities or with slight modification of them. The Committee on Economics of Railway Operation of A.R.E.A. has suggested the following methods of handling this problem.[1]

1 A.R.E.A. Proceedings, [illegible]

In considering the means of increasing traffic capacity of a railroad, the logical first step in an examination to ascertain

1 If the facilities as they exist are being utilized to the maximum capacity;

2 What changes, if any, in methods of operation will produce increases of capacity;

3 What minor additions or alterations to facilities can be quickly made which will produce increases of capacity.

It will be seen that the examination must deal largely with the operating organization of the railroad. It must determine if there is intelligent supervision, if there is proper effort on the part of men in the ranks, if there is co-ordination of the several departments if a proper esprit de corps pervades the organization; in short, if the performance of the machine in the hands of the organization is of a high standard of efficiency.

The examination should be started by a preliminary study of the operating conditions in the district. This will to a large degree determine the scope of the more thorough and detailed study which shoul follow. These studies can best be made by examinations of the movement, locomotive performance and their operating records, the comparison of the current performance with those of former periods, and by consultation with the operating officers having the district in charge.

The preliminary study will probably disclose one of two operating situations.

1 A heavy traffic being moved with comparatively free road and terminal movements, the volume of business handled approximately equaling or exceeding that of prior periods of good performance.

2 The road movement free and the terminals--one or both--congested, or both raad and terminal congested, the volume of traffic moved being less than during former periods of good performance.

The first case is one requiring very careful study and mature consideration before steps are taken looking toward increasing the capacity by changes in the methods of operating the district. When a heavy traffic is being moved, it is logical that the number of cars in yards will be high, that there will be many trains on the road and therefore much interference in train movement that the locomotive terminals will have large number of locomotives to handle, that all the facilities will have heavy loads imposed upon them. Nevertheless, to obtain the maximum capacity, the road and the terminal movements should be kept as free and unrestricted, and less crowded, the [illegible] [illegible] of any part of the machine should be reduced to a minimum. It is true that crowding of facilities will follow speedily if there are interruptions to traffic and they will doubtlessly be frequent. If of short duration the resulting accumulation will be overcome by the reserve power of the organisation; if of long duration other means of relief should be resorted to, such as the diversion of traffic to other routes and the restriction of loading by embargoes, but the remedy, whatever it may be, must be applied promptly and vigorously

so as to avoid congestion and its attendent losses of efficiency and capacity. The length of time necessary and the difficulty experienced in overcoming this accumulation of freight will give some indications of increasing the movement of traffic over the district.

It will undoubtedly be found that the officers are well informed as to the limitations of the district and can point out those facilities which are being utilized most nearly to their capacity and which first show signs of overloading, and perchance they will have available the results of experiments which have been made with the view of increasing the traffic capacity so that the expediency of possible changes of operating methods can be definitely determined without the necessity of experimentation, which is in itself very objectionable on a road working approximately to its capacity.

It will be found that the performance of the men is generally good, that trains start promptly and move into and out of sidings with precision; that there are very few accidents caused by non-observance of rules or by carelessness of trainmen; that the condition of tracks, locomotives and cars is good; that the locomotives attain a high average mileage, and that detentions for cleaning fires, washing boilers, making running repairs, etc., are reasonably low. All trains will be found to be handling [illegible] the local work being done by the local freight and pick-ups, thus reserving the thru trains for long haul freight. The schedules for calling extra freight trains have been so arranged that the movements

of these trains will best fit in with the schedule of the passenger trains and shedule freight trains. In short, the examination will disclose an efficiently operated district in charge of officers who know the limitations of facilities and who are in a position to and do restrict the business should the ocassion demand it so that the facilities will not be overloaded.

The subsequent study should be confined to those facilities and features of operation which, as have been developed in conference with the officers, are the first to give troubles under increase of traffic. A brief discussion of two or three assumed cases will indicate the methods to be followed.

Assume, first, that the ash-pit at one terminal becomes overloaded and power is delayed there:

Careful observation of the operstion of the ashpit and tracks leading to and from it should be made covering periods of sufficient length to thoroughly familiarize the observer with them. This may disclose that slight rearrangement of tracks or other facilities will be beneficial; as, for example, the building of an additional cross-over or the relocation of a water column. It may bring out that some part of the organization needs strengthening. If the capacity of the pit itself is the limiting feature, consideration should be given to affording relief by installing steel ties in an adjoining track for a length of eighty to one hundred feet and the cleaning there of the fires of yard engines and other small power during the heavy periods of the day. Means may be found also of changing the runs of certain

[illegible] where the facilities are less crowded, [illegible] terminal under examination.

Assume, second, that one of the yards is unable to keep up with the switching under increasing business:

Observations of the work of all parts of the yard should be made by capable men. If these should develop any lost motion, interference of the work of the yard crews by other yard crews or by road crews, inefficient use of road power, etc., by careful planning, and possibly by some minor improvements which can be quickly made, some of these difficulties can be overcome. Consideration should be given to the question of systematized classification of freight at other yards thru which it moves so as to reduce the work of this yard. If practicable a part of the trains should be so made up as to pass this yard without switching. Some feasible changes in the yard power may be found desirable.

Assume, third, that the road movement gives trouble:

A study of the train sheets will indicate where to look for the cause. It may be found that [illegible] would be beneficial, that [illegible] practicable; that a very slight reduction in the tonnage rating of [illegible] will [illegible]

power, and in this way the capacity of the railroad be increased.

The second situation, that of congested engine district, present an entirely different problem. It can be stated without fear of contradiction that an engine district that is continually congested for a long period can not be handling traffic to its maximum capacity. Congestion carries with it heavy delays to trains getting out of and into yards, slow movement on the road, the holding of trains out of yards, [illegible] of service [illegible] excessive interference to switching in yards and an increased quantity of switching, crowded ashpits and engine houses, tired, indifferent men, carelessness, accidents, petty and serious; with damage to engines, cars and tracks, all resulting in inefficient use of power, of facilities, of men, in a general slowing up of the movement and in a reduced capacity of the road.

When such condition exists, it is necessary, in order to bring about any lasting improvement, to determine the seat and the cause of the congestion before remedial action can be taken. Congestion in one or both of the terminals at the extremities of the engine district does not necessarily affect the road conditions to any serious extent, for while it may be necessary to set trains off at sidings on line of road and to hold other trains out of the yards for varying periods, thus causing inefficient use of power and crews, the result will be a tendency to increase the terminal difficulties and if proper precautions are taken to saveguard the road movement, it will continue to

on line and terminals. The general road movement, on the other hand, cause a general slowing up of trains and a consequent inefficient use of the available power and crews, so that even if the terminals are adequate to handle the traffic with free road movement they will be over crowded with movable cars, switching will be made difficult, and unless handled very skillfully, congestion of the terminals themselves will follow as a result of the road congestion.

If it is found the road movement is as a rule free while one or both terminals are congested, then it is necessary only to see to the terminals for the cause of trouble. If both roads and terminals are congested, the difficulty may lie entirely with the road conditions, but the chances are that the congestion in the terminals, brought on perhaps by the inadequate road movement, has been aggravated by unfavorable conditions within the terminals themselves.

The detailed studies then should embrace both road and terminal facilities, organisation and operating methods or such portions of them as the preliminary investigation may indicate are necessary. They should be made by consulting the train sheet and the various daily and periodic reports of operating performance and by making comparisons with the performance during previous periods, by suitable observation of actual work and by free discussion of the existing conditions with the officers in charge of the operation.

A practical outline of some of the elements which effect the capacity of a railroad.

Line capacity, affected by

Method of train operation----Signaling system
Segregating trains
Scheduling extra trains out of terminals
Running speed
Tonnage rating
Handling local work by locals or pickups
Helper stations

Derailments and accidents---Defective tracks
Defective equipment
Carelessness
High speed

Performance of power-----------General condition
Running repairs
Preparation
Fuel, water.

Yard capacity, affected by

Work to be performed--------Quantity of switching
Overcrowding
Yard design

Performance of power---------General condition
Running repairs
Preparation
Fuel, water

Derailments and accident----Defective tracks
Defective equipment
Carelessness

Engine terminal capacity, affected by
Ashpit, turntable, coal chute and supply track capacity
Running repairs

Signaling systems----The [illegible] of trains [illegible] train orders and rules, manual block signals, automatic block signal or interlocking

If the spacing is by train order and rules, consideration should be given to establishing the Manual Block system. The cost will probably be light and the advantages in reduced liability to accident great. Determine if the system in use is functioning properly and if additional telegraph office or block offices or signals are required to shorten the particularly long blocks. Consider the possibility of the modification of rules looking to expediting train movements without sacrifice of safety, as for example the fullest practical use of the "19" order.

Dispatching Force.---A first class train dispatcher will work wonders with a busy railroad, while one who is not capable, whether from inexperience or other causes, is entirely out of place where there is congestion. Determine if the dispatching force is competent and adequate, if the dispatchers are found up to the mark and still trains are being delayed for orders, give consideration to subdividing the district, adding an additional set of dispatchers. The dispatchers must keep a constant pressure on train movement. They must not be on the defensive.

Scheduling extra freight out of terminals.---It will be found that the chief dispatcher will [illegible] [illegible] so as to avoid passenger trains and [illegible] freight trains in getting out of the terminals. Take the advantage to the fullest extent of the time he is [illegible]. Call into conference the Superintendent, Trainmaster, Chief Dispatcher and Travelling Engineer and prepare a schedule for each terminal of the leaving times of all extra trains for the [illegible] period. [illegible]

[illegible]

[illegible] will soon be evidence of preparation to meet the schedule, power will be selected in advance, the yard crews will speed up to get the trains ready, the trainmen will watch their standing on the crew board and be prepared to promptly respond when called. Regularity and certainty will prevail and trains will leave terminal on schedule--a good start for a good run.

Running speed---Do the slow trains drag up-hill at snail's space with slippering drivers, stalling if the steam pressure drops a few pounds below the maximum? When over the hill do they roll away, passing the bottom of the sag at passenger train speed--"as fast as a wheel will turn over?" Both are objectionable. The first tends to [illegible] [illegible] wear and tear on track and equipment and tends to accidents--and freight train accidents at high speed are usually serious. Moderate freight train speeds tend to reliability and safety. They sacrifice little in time saving and quicker movement as compared with excessive speeds on descending grades.

Tonnage rating---Increased traffic means more ton miles produced. Look well then to the tonnage rating of the locomotives. Proper tonnage rating does not mean overloading the locomotives. It does [illegible] on the ruling grade.

It means all trains of the same class uniformly loaded in the direction of heavy traffic. It means full trains from terminal to terminal. It means uniform performance. If the tonnage ratings of found to be low, do not hesitate to increase them but do this gradually. Add one car per train and run this way for a week, then add a second car. Keep this up until the proper rating is reached and the psychological tendency to oppose increased train load will probably be avoided. If on the other hand it is established that the rating is too high, it should be reduced. Difficulty in starting trains, slow movement into [illegible] stalling when the rail is bad and other unfavorable conditions exist, result uncertainty delay and inefficiency. Rate the locomotives to their capacity, so as to provide a reliable, dependable movement of trains.

[illegible] ileage, a train must move thru foom one terminal to another with full tonnage. When this is done with a minimum delay efficient operation is obtained. If the thru tonnage freights are to make good runs [illegible] them but to make the other end of the road. This is one of the surest ways of increasing the ton miles per hour of crew time and the ability to handle traffic. If the local work is light, it can all be handled by the local freight but this local must not be overloaded. It will necessarily meet with

[illegible] station unloading freight and switching, and in order to get over the road in a reasonable working day its tonnage will have to be light so that it can make quick moves from station to station and in [illegible]

Therefore, when the carload business is heavy, pick-ups must be run as necessary to keep freight well moved up and the road free of cars.

[illegible]---If [illegible] In scheduling the slow freights out of the terminals, favor the [illegible]er stations as far as practicable. Consider possible changes in the helper runs and the loading of thru trains to the end of increasing the efficiency of the helper and road power.

Defective track---Poor track is responsible for a large percentage of derailments. There are two remedies: The first, repair and build up the track. The second, reduce the speed of trains to the safe limit. This remedy can be applied immediately with certain results. Rather reduce speed of trains than suffer frequent interruptions to traffic and expensive derailments.

Defective equipment---If the accident report show an excessive number of derailments caused by defective equipment, an analysis may indicate that inspection at a certain terminal is poor or that a particular [illegible] the trouble. More careful inspection [illegible], when [illegible]

[illegible]

[illegible], collisions, destruction [illegible] in traffic. Such a situation requires quick but careful discipline, [illegible]h and relentless investigation of all accidents and detached [illegible] of rules and the free use of efficient tests. Porper method will [illegible] the spirit of carelessness and as the [illegible] improve, there will appear among the men a spirit of pride [illegible] part of an alert, effective organization.

[illegible] speed---Excessive speed will produce derailments even if [illegible] tracks and equipment are in [illegible] condition; in combination with [illegible]e tracks and equipment it is a fruitful source of accidents. [illegible] at high speed usually results in serio[illegible]

[illegible]

[illegible] locomotive after receiving general repairs should [illegible]

[illegible] the district more shop space or [illegible] by double shifting in the machine [illegible] or parts of the shop which is [illegible] relief, consider having a number of [illegible] railroads or by contract shops.

Running repairs---If there is any one thing that is disheartening [illegible] railroad two or three [illegible] with their trains, their movements will be slow and unreliable [illegible]

[illegible] locomotive until all required repairs are completed. If [illegible], the failures will be many. Watch closely the number of engines held for running repairs; if too high, ascertain trouble and apply the remedy. If necessary, inceease the force assigned to running repairs, as a last resort [illegible] in order to do this. By all means see that this work is kept close up, for it [illegible] serviceable locomotives and good performance on road.

[illegible]---[illegible] worn out parts--defects in the locomotive itself--or from [illegible] resulting from improper preparation, such as obstructed flues, foul [illegible], dirty fires, etc.,these conditions other than those repairs, which are remedied in preparing the locomotive for the next trip. If it is developed that failures are being caused by improper preparation [illegible] ashpit and roundhouse forces to remedy this. It may be well to temporarily place a special inspector to thoroughly inspect and [illegible] the condition of all engines before they are turned over to the road crews.

Fuel and water---Determine if the fuel is of good quality and [illegible]. Also see that the locomotives are suitably [illegible]. If the fuel is poor, a great opportunity [illegible] quality of fuel is available. [illegible] but [illegible]

[illegible]

[illegible]

consider relief thru hauling water of good quality.

Quantity of switching---Freight trains can be put thru a terminal with regularity in from ten to thirty minutes if there is no switching to be done. If they have to be broken up and classified or consolidated with other trains, several hours will be required. If [illegible]

[illegible]

[illegible] to reduce switching in this yard. Consideration should be [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

of systematizing the switching.

Overcrowding---The work of any yard will be badly hampered if it is continually crowded. Effective switching requires open tracks [illegible]

[illegible] tracks, the interference with switch engines by other [illegible] engines and by road engines, increased liability of collision [illegible]

[illegible]

[illegible]

in this yard or to reduce traffic temporarily by embargoes until normal operating conditions are restored.

Yard design---While any extensive changes in a yard under heavy traffic would not come within the scope of this particular study, careful consideration should be given to the possibility of increasing the capacity by minor changes in design. For example, It may be found feasible to revise the summit of a hump a foot or two so as to give the cars a quicker run-off; to lengthen a few tracks so as to avoid road trains doubling over; to make changes in the arrangement of switches at some points so as to avoid interference and reduce switch engine movements, or to put in a stand-pipe and prevent loss of time on account of switch engines running for water. In general, the effect of the performance of power, derailment and accidents on yard operation is similar to that on road operation and the discussion of the causes and conditions affecting them given above can be applied with suitable modifications to adapt them to yard work.

Ashpit, turntable, coal-tipple, and ready track operation---Determine if the facilities and appliances are maintained in such condition as to give efficient operation, if coal and cinder cars are properly switched to a from the coal tipple and cinder tracks as required; if the necessary tool, torches, etc.; are provided . Careful observation should be made to determine if any change in routing of locomotives to and from the ashpit and enginehouse will reduce the interference and prevent [illegible] of movement. The ashpit turntable and

[illegible]

will pay large returns in increasing the capacity of a railroad.

Chapter 7 Locomotive Performance

- Utilization of Power
  - Assignment of Engines
    - Uniform Length and Weight
    - Similar Types
    - Laid-off Power
    - Assigned Engines
  - Assignment of Crews
    - Assignment System
    - Pooling System
    - Relay System
    - Line System
- Supply of Power
  - Percentage of Power in Service
  - Running Repairs
  - Engine Cleaning
  - Engine Coaling
  - Changing Power at Outlying Points
  - Engine Failures--Causes and Remedies
- Proper and Economical Handling of Power
  - Quality of Fuel
  - Local Studies
  - Effect of Speed
  - Effect of Mechanical Defects
  - Wasteful Habits and their Prevention
  - Coal Handling
- Steam Economy
- Watering
- Lubrication
- Minor Economies

[illegible]

[illegible] 5 [illegible] (1) the utilization of power, (2) the [illegible] of power, and (3) the proper and economical handling of power.

[illegible] utilization of power.

The method of obtaining the greatest possible amount of service from the existing supply of power is a matter of great importance. The railroads are generally confronted by the two problems in the matter of the utilization of power, namely: (1) to keep a sufficient number of engines in service to handle the business especially during [illegible] period, and (2) to put the engines of various designs and ages in work that would best suit their respective utilization.

Assignment of engines. In assigning engines, all the features of train operation must be taken into consideration. A heavy locomotive which will haul large tonnage at low cost when operated on a line with inadequate facilities will be uneconomical. "The cost of handling [illegible] particular train may be low, but the result of the operation in [illegible] to other traffic, may more than offset any possible advantage."

It is a good practice to assign engines with uniform length and weight over the entire line. It has particular advantage in through freight service where solid trains can be handled over a number of division without [illegible], thus speeding up the movements. However, some [illegible] In order that trains may [illegible] light engines must be assigned t

the level division and the heavier ones placed where heavy controling grades tend to hold down train loads. It is, therefore, sometimes necessary to split divisions, using the heaviest power over the steep grades and doubling them back to the terminal, while lighter engines handle the train over the more level part of the line. This requires [illegible] ability, and is not always economical. "Two [illegible] of delay is at least doubled." Again, trains of excessive length have some disadvantages. The pulls and jerks will be hard on equipment on single tracks with sidings of limited length, long trains tend to slow up the movements.[1]

The assigning of engines of similar types to one division has many advantages. First of all, it is necessary to carry only one type instead of many different types of parts for engine repairs, hence, [illegible] of useless parts. [illegible] ing, [illegible] type of engine, the local roundhouse and shop forces will be especially expert and efficient in handling the repairs of that particular type. Again, the trainmen will have more interest and favor a particularly familiar engine rather than a strange one.[2]

It is a good practice that only a sufficient number of units is assigned to service to adequately protect the current business. Any excess of power in season of light business should be laid up in good condition to await the heavy traffic [illegible] the round houses and shops are most stringent in accommodation.[3]

1, 2, [illegible],: Railroad Operatio[illegible]

[illegible] "[illegible]" and "[illegible]" [illegible] used to great advantage. On heavy li[illegible] [illegible] segregated by using double headers [illegible] movements and clearing the traffic. [illegible] on [illegible], [illegible]. Moreover, they reduce the expense of [illegible].

[illegible] [1]

[illegible] crews to the engines have [illegible].

[illegible]

[illegible] The crew take the greatest interest and pride in its engir[illegible]

[illegible]

[1] [illegible]

[illegible]

[illegible]

[illegible] and each engine crew goes out with the engine which [illegible] available for the run for which it is called." This "first in [illegible]" method has the following advantages:

[illegible] The maximum mileage can be obtained from the engine, inasmuch [illegible] motive does not require as much rest as a man does, it can [illegible] out as fast as it can be handled. It is believed that the [illegible] can be increased over 33%--50%.

[illegible] thus it provides for the maximum tonnage with the minimum [illegible]

[illegible]

[illegible] hand, it has its disadvantages in that (1) since [illegible]

[illegible] engine house and shop forces upon whom fall the exceptionally [illegible] inspection and repairs and the constant discipline of crews in [illegible].

3 Swing system. By "swing" system, three crews in a group [illegible] assigned to two engines. "While two crews are regularly assigned [illegible] locomotives, the third crew runs alternately the first and the [illegible] second locomotive, swinging from the one to the other". By this [illegible], the power is utilized all the time yet the crews are given pro- [illegible]. Further, "it makes possible to keep crews on engines of [illegible] from [illegible]

[illegible] interest and attention.

[illegible] The "link" system, Little practised in U.S., [illegible] runs. [illegible] applied where there is a greater number of crews working with [illegible] of locomotives, and any one link does not comprise [illegible]

[illegible] "pooling" system in [illegible]

[illegible]

The supply of power.

[illegible] condition and in readiness for service [illegible]

Percentage of power available for service. [illegible] engine performance. It should be possible, under ordinary conditions, to keep at least [illegible]% of the power in serviceable condition at all times. This, to a great extent, naturally depends on the shop facilities and forces, the age and design of the locomotives, and the condition of fuel, water, grades and curves, tonnage and speed under which they are operated.

Proper running repairs and [illegible] of locomotives will [illegible] necessary to have it completely [illegible]

[illegible]

[illegible] will be. In the case of "pooling" system [illegible] t be expected to have a thorough knowledge of each [illegible] pendence must be placed upon their reports.

[illegible] is of great importance. "A thin coat of scale [illegible], means a heavy decrease in the heating efficie[illegible], [illegible] and a foaming boiler is not only annoying but de- [illegible]. Every dollar spent in frequent and thorough boile[illegible] will usually return five dollars in fuel economy and reduced [illegible]".[1] [illegible]

[illegible]

[illegible]aration for service. In addition to the reduction of [illegible]

1. [illegible]

2. [illegible]

[illegible]

[illegible] engine number, the train number, and the time of arrival, etc.

3. The hostler clears the ash pan and cleans the fire; then [illegible] the engine to coal dock for taking coal, to penstock for filling [illegible], to tool track where tools are removed, and to wash [illegible]

[illegible]

[illegible] house. A fresh coat of paint may be applied.

[illegible] A report is made to the yardmaster.

[illegible] When the locomotive is ordered for service, it is fired and [illegible] tank filled with water and [illegible]

[illegible] him [illegible]

[illegible]

[illegible]

[illegible] and the engines must [illegible] departure. Caboose [illegible] thereby avoiding delays incident to backing trains to [illegible]

[illegible] thru train, the engine and crews can be changed at the out- [illegible] of the yard. "As the train approaches the yard, the [illegible] ff at a distance of about half a mile and brought [illegible] yard engine with the relief caboose, as soon [illegible] cks out on the main track, comes up and cou- [illegible] train stops, the road engine cuts off [illegible] the cuts of cars to be uncoupled. Then the rel[illegible] of cars that is to be added, standing ahead on the [illegible] on to the train. When the train is set in [illegible][1]

[illegible]

[1] [illegible]

[illegible]ineman's failure to [illegible]

[illegible]

[illegible] should be secured accordingly.

[illegible]

After the power is well maintained in running condition, and [illegible] its best possible utilization, there remains an im[illegible]

[illegible] properly handled as to avoid any damage to equipment [illegible]

[illegible]

[illegible] the following instructions are of value:[1]

1. [illegible]

2. [illegible]

3. [illegible]

4. [illegible]

5. [illegible]

1 [illegible]

6. [illegible]

7. [illegible] entering a long and sharp descending grade where a [illegible] call will be made on the braking power, stop the [illegible] [illegible] gears are in good condition.

8. Before starting a new run, examine the [illegible], because of increased liability to friction, repaired machinery [illegible].

9. Keep the journal box closed and air-tight.

10. Avoid hot-box by the application of a small [illegible]

11. [illegible]

12. Investigate promptly the details and the [illegible] in working.

"[illegible]

"The [illegible]

[illegible] of those doing the handling. They must study and see that they give quick handling with low impact speed and [illegible].

"In starting a train, it is important to keep the engine at a slow and uniform speed for about two car lengths, a lesser distance may have started the entire train and cause the break-in-two, 85% of which occur in starting.

"Long trains can not be stopped within a few feet after beginning the brake application either of the locomotive brakes or of the train brakes without producing shocks. The stop must, therefore, be gradual and the brake application made sufficiently in advance of the stopping point so that it will not be necessary to develop a heavy brake cylinder pressure on any application of locomotive brake or on any reduction when using the train brakes. The train brakes or the engine brakes should not be applied if the characteristics of the [illegible] are such that easing of on the throttle a little farther back would produce a gradual stop without allowing the slack in the train to change.

"Another cause for loss and damage is that of damaged wheel. The cracked and broken wheels are caused by operating trains on high speed with retainer in use for considerable distance without stopping to cool wheels, and the slid flat wheels occur under the low speed and heavy braking. Cars should, therefore, not be moved any greater distance, [illegible], [illegible] applied, [illegible]

[illegible]"[1]

[illegible] an accident, as defined by H.S.Haines, is "[illegible] which interrupts the normal train movement." [illegible] or equipment or regulation; it may [illegible] (1) [illegible] (2) [illegible] train in sections and caused by deficient [illegible] (3) [illegible] caused by cars standing on a siding so near the main track as [illegible] (4) [illegible] collision, [illegible] train, or making irregular [illegible].

[illegible][2]

[illegible]

1 [illegible]

2 [illegible]

3 [illegible]

[illegible]

[illegible]

[illegible]

[illegible] must be called.

[illegible]

[illegible] "proceed signal" must be given before passing a [illegible] must be watched for by the men on the [illegible] and if not received, [illegible]

[illegible]

[illegible] when necessary.

9 Stop and caution signals must be respected.

10 Enginemen must not act on signals unless they [illegible] intended for them.

11 [illegible]

12 [illegible]

13 [illegible]

14 [illegible] must be [illegible] at the proper [illegible] distance [illegible] between the trains.

15 The engine must be inspected thoroughly at least once every 20 miles.

16 The engine must be detached from the train before [illegible] [illegible] at point where water is taken.

17 Flag [illegible] must be displayed at the proper distance from the point where the train must be stopped.

18 [illegible] must be [illegible] in [illegible].

19 Targets must be in good line.

20 Operators must [illegible] [illegible] as [illegible] by the rules.

21 Night signals of all kinds must be displayed at the proper hours and markers displayed on [illegible] [illegible] [illegible] [illegible] for [illegible], and should the air not be cut thru, the [illegible] [illegible] [illegible].

Fuel Economy

Fuel consumption constitutes one of the largest items of operating expense. It involves not only the price of the fuel itself but also the cost of transporting fuel over the line to the place of consumption and of handling it from cars to tenders. Saving in fuel means a decrease in operating cost and at the same time permits the opportunity of [illegible] the haulage of a [illegible] [illegible] [illegible] [illegible] tion.

The quality of fuel furnished must be determined by the [illegible]

of the [illegible]. A locomotive with large grate area and ample [illegible] [illegible] will handle low grade fuel to good advantage, while the same grade fired in a narrow fire box with small heating surface would be quite wasteful. [illegible] grades of coal [illegible] in the same engine is an undesirable practice. "Locomotives need to be specially drafted for the class of fuel they are to burn, and frequently different grates or grate arrangements are necessary to get the best result from different grades of coal. Stokers, arches and other mechanical devices [illegible] with the firebox [illegible] [illegible] adjustments to fit the fuel used. When different grades of fuel are furnished to a locomotive at different times, the full heat efficiency can not be obtained from all classes, and the chances are that it will be obtained from none."[1]

The relation between train load, speed and fuel consumption varies in each territory and each direction and can best be solved by local studies. For each weight train in each direction there will be a definite speed at which the minimum coal consumption will result, and with speeds either higher or lower than this definite speed there will be an increased fuel consumption.[2]

The handling of heavier cars and heavier trains with moderate but not excessive speeds will reduce fuel consumption. [illegible] speed [illegible] [illegible] the [illegible] [illegible] material [illegible] [illegible]

1 [illegible]

2 [illegible]

[illegible]

[illegible] for long periods awaiting service is a common source of wastes of fuel, the remedy for this lies in efficient dispatching. Forcing [illegible] us[illegible] of fuel.

"[illegible] excessive fuel consumption. When a locomotive runs hot, [illegible], when there is lost motion in its rod, it requires [illegible] to overcome its disabilities."[1]

[illegible] somtimes adapt wasteful practices without knowing they are wasteful. Some engineer gets in the habit of running with their levers [illegible]; others amuse themselves by lifting the fire off the grate [illegible]. Firemen may get into wasteful habits unconsciously. To a[illegible], individual performance records must be kept for comparison [illegible].

Rega[illegible]

[illegible] scattered more uniformly over the brightest spots. The coal [illegible]

1 [illegible]
2 [illegible]

[illegible] [illegible] the flues [illegible]. [illegible] along the side of the firebox and in the corner to exclude the cold air and to avoid chilling the combustion, fire box and flues, and the throat sheet. [illegible] firing results in [illegible] [illegible] with cooling of the fire box and flues. Coal should be fired in small quantity and regularly allowing the fire box door to remain closed a few moments between shovelfuls for the furnace to regain its temperature. The fire bed must be kept thick enough and of uniform depth over the entire grate surface to prevent too much air. To provide for a full admission of air thru the grate to effect combustion the grates must be shaken to keep them free from ashes and clinkers. [illegible] pressure should be kept within the limit of five pounds [illegible] way."[1]

[illegible]. According to L.F.Loree's statement, for every 100 [illegible] in [illegible] coal not more than 60% is actually utilized in producing tractive power. Of the [illegible], [illegible] is [illegible] in producing the draught for combustion, evaporation and superheat; is applied to accessories, such as coal pushers, stoker conveyers, etc.; is used [illegible] compressed air for [illegible]. [illegible] safety valves [illegible] [illegible], [illegible] [illegible] [illegible] [illegible] the speed and load conditions and the use of [illegible] valves to control speed. "[illegible] in steam [illegible] by cutting off the supply early in the stroke and allowing the steam to expand [illegible] [illegible] in pushing the piston the remainder of the stroke [illegible]

[1] [illegible] [illegible] [illegible] P.[illegible].

[illegible] steam to enter the

[illegible]

[illegible]

[illegible] starting the train, work the locomotive full stroke and [illegible]le the steam so as to prevent the slipping of driver-wheel whi[illegible] [illegible] of fuel."[1]

[illegible] Before starting an engine, the boiler should be [illegible] water heated to the proper temperature. The [illegible] various conditions of work should [illegible] be a good supply of water in the [illegible] when beginning the ascent of a grade as the injection of cold [illegible] checks the formation of steam. "While the water should not run [illegible] the margin of safety, the boiler should not be so full with [illegible] that the steam will carry the water over into the superheater [illegible] when the engine starts."[2]

Lubrication. Too much restriction on the use of lubricants as [illegible]y inferior lubricants that results in excessive friction is a [illegible] economy; on the other hand, over application of oil is wasteful. [illegible] movable part that will create friction should be kept well [illegible]ted. Oil holes stopped up should be promptly cleaned. "Oiling [illegible]" should be done carefully, looking into the condition [illegible]

[illegible]

1 and 2 [illegible]

PART III [illegible]

Chapter [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Freight Brakeman

[illegible]

Road Foreman of [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

PART [illegible]

Chapter [illegible] Supervision, [illegible] and Responsibility

[illegible] Competent man power can be had only thru the supervision and discipline of the officers, the interest and loyalty of the employes, and the responsibility and [illegible].

The employes of the railroad are scattered over thousands of miles of line and perform duties almost as various as those of all the trades in existence, and the individual must be responsible for the performance of the task allotted to him. However, in order to insure efficient performance, it is the duty of the officers to [illegible] It was [illegible] said by a Superintendent of the [illegible] Railway that the officers are morally responsible for the actions of their employes.

After all, with a field so broad and task so diversified, team work or cooperation, in all directions is the most essential factor in the efficient operation of the railroad. [illegible]

[illegible]

[illegible] element in the organization. [illegible] of the University of Pennsylvania, [illegible] Vice President of the Pennsylvania Railroad, [illegible] [illegible], the first answered drowsily: "I cut stone"; the second answered indifferently: "I work for $10 a day"; the third answered proudly: "I [illegible] building a Cathedral". Unless every railroad man enthusiastically [illegible] his work as a railroad in itself, in Mr. Lee's opinion, [illegible].

It is important, therefore, that every employee should be shown the nature of his work, its importance and its effect upon the railroad as a whole. The following paragraphs will discuss the duties of the various [illegible], so as to [illegible] the scope of work and the responsibility of each.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] the Supervising Agent. [illegible] ngs and grounds at his station. I[illegible] [illegible], and collection for the same; to see that cars are promptly [illegible], unloaded and forwarded; to make reports in the manner pre-[illegible].

[illegible] must see that cars left at his station have the hand brakes [illegible] structing tracks while loading and unloading cars; freight [illegible]

[illegible]

[illegible]

[illegible] be illustrated as [illegible]

(1) [illegible]

1. [illegible]

[illegible] waybill [illegible]

Rate clerk

Billing clerk

Revision clerk

[illegible]

[illegible]

[illegible] clerk for inbound [illegible]

Transcribing cler[illegible]

Stripping clerk

[illegible]

[illegible]

[illegible] hier and his assistant

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

The work and duties of [illegible] manifested [illegible]

[illegible] need no explanation. But as to the [illegible]

[illegible] of "the company [illegible],

[illegible]".

[illegible]

[illegible] to a minimum [illegible]

[illegible] in loading [illegible]

[illegible] carefully balanc[illegible]

[illegible]

[illegible]

[illegible] the condition of traffic.

Good discipline has much to do with economic operation, the [illegible] tice will be a definite line of promotion with a number of [illegible] "[illegible], receiving the lowest rate of pay; second, loaders, with [illegible] over the minimum; third, stevedores or stowers, [illegible] increase over the minimum, who shall finally be [illegible]. Even a slight difference in wages is [illegible]."

[illegible]

[illegible] instructions from the [illegible] Superintendent. He takes charge of the movements of traffic, [illegible], and supervises train and yard forces. He attends to [illegible] [illegible] stances lest his men [illegible]

[illegible]

[illegible] receives [illegible]

[illegible] (3) [illegible] waybills are received for cars arriving; (5) [illegible] (6) [illegible] (7) cars are not de-[illegible] (8) [illegible]

[illegible] rules only. [illegible] exert ingenuity for meeting small and great emergencies and [illegible] vigorously to keep things going and to encounter any problem [illegible] ordinary accidents, unusual weather, inability to [illegible] yard power, injuries to employes, obstructions [illegible] yard. [illegible] must above all things, retain his composure and control his [illegible] in order to avoid the effect of confusion on his subordinates. [illegible] of heavy and unusual train movements [illegible] caught in the state of confusion.

[illegible]

[illegible] obeys orders of the yardmaster. He must report [illegible] appointed time and examine the bulletin board. He must [illegible] (1) the trainmen are ready for duty; (2) he has the [illegible] waybills for the cars to be moved; (3) [illegible] (4) couplings and brakes are [illegible] condition, (5) [illegible] (6) [illegible] their proper places. [illegible]

[illegible]

[illegible] and notice is given before moving cars from the station [illegible] tracks. He must take care of runaway trains or cuts of [illegible] hot boxes and journal or draw-heads pulled out; clean up [illegible]nts and minor wrecks; furnish correct information for the [illegible], estimating as closely as possible when his train is ready [illegible] that the dispatcher can communicate with the opposing [illegible] it gets beyond his control; decline to act on [illegible] of proper signals in protecting train; [illegible] damaged part on the main tracks; report the absence and de-[illegible] of fixed signals. He must always ride in the caboose and ins-[illegible] sides of the train at stops to enable the prompt discovery [illegible], etc. He must make Wheel [illegible]ment.

[illegible]

[illegible]'s principal responsibility is the reduction [illegible]. He attends to the switching and weighing [illegible] [illegible]r icing, stock cars [illegible]

[illegible]

[illegible]

[illegible] of cars and other i[illegible] advise the brakemen o[illegible] [illegible]. In cold weather when cars do not run well, he must see [illegible] cars clear tie frogs and do not foul the cl[illegible], conductor should work in close touch with the [illegible] cuts of cars that can not be held by the riders [illegible] plenty of space in which to bring them to [illegible] the switch list [illegible] yard office having marked opposite each car number the identi-[illegible]

[illegible]

[illegible] freight brakeman reports to and receives instructions from [illegible] and obeys orders from yard master and follows the direc-[illegible] conductor on duty. He assists in making up his train [illegible]

[illegible]

[illegible]

[illegible] Engines

[illegible] the proper [illegible] and supplies. He must see that the engines [illegible] ed; must know the proper [illegible] for each class of engines; must [illegible] house foreman respecting the condition and requirements [illegible] repairs when necessary.

[illegible]

[illegible] engineman reports to and receives instructions [illegible] Engines and obeys orders of the train master, [illegible]

[illegible] signals and supplies; [illegible] of time table, comparing the time with the conductor before starting. He assists in shifting and making up trains, gives checks for [illegible] and supplies received, instructs fireman in performing his work, and assists in making repairs when necessary. He must exercise [illegible] and good judgment in starting and stopping trains and in [illegible] and coupling cars; keep a constant look-out for signals and [illegible] acknowledge all signals except fixed signals; stop and investigate any signal not understood and train when necessary; use [illegible] against fire, permitting no burning waste, hot-cinders, etc. [illegible] dropped from engine, cleaning the ash-pan or front-end only at [illegible] points; report the condition of engine at the end of [illegible] and misconduct and negligence on duty. In general, he is [illegible] to get the most out of locomotive at the least cost, and to [illegible] perfect control of speed, and facility in handling of [illegible] to the best method of economizing combustion and steam.

[illegible]

The fireman reports to and receives instructions from Road Foreman [illegible] and obeys orders from train master, engine house foreman and engineman. He must report for duty at the appointed time and [illegible] trains, [illegible] look-out [illegible] for signals and obstructions, [illegible]

[illegible] he must see that tools are put [illegible] just sufficient fire left to be cleaned [illegible]

[illegible]

[illegible] master mechanic reports to and receives instructions from [illegible][1] and obeys orders from the superintendent of [illegible] standards. He takes charge of shops, power [illegible] of employes therein, keeps [illegible], and is responsible for the proper maintenance [illegible] and tools. He must consult and advise [illegible] respecting the economical performance of [illegible] requirements [illegible] in construction and repairs; forbid works [illegible]

[illegible]

[illegible] mechanic [illegible] has charge of engine [illegible]

[illegible]

1. [illegible]

[illegible]

[illegible]

[illegible] and receives instruc-

[illegible] of station agent and yard-

[illegible]

[illegible] and send to the shop cars not fit for service.

[illegible] see that the load on all cars is properly placed and does not

[illegible] quantity and standard dimensions

[illegible] working under and above trains and cars display

[illegible]

[illegible]

The Chief Dispatcher may report to and receive instructions from

[illegible]t. His duties are to handle crews, [illegible]

[illegible] properly crews and power; check train orders

[illegible]

[illegible] the causes of overtime, [illegible]

[illegible] check tonnage statements and [illegible]

[illegible] the distribution [illegible]

[illegible]

[illegible] mechanics, agents, operators, or others to report for [illegible] outside of their regular time of service when exceptional con- [illegible] it; supervise tracing of loaded and empty cars; keep [illegible]

The Chief Train Dispatcher must [illegible] being [illegible] and per diem and [illegible] train reaches the [illegible]

[illegible]

[illegible]

[illegible] in time; nor to instruct one crew [illegible] getting in overtime or [illegible] another train in sight which can do the work much easier, on [illegible] of being not overloaded; nor to order several crews to "fill out" [illegible] along the road until the full tonnage is taken on, [illegible] many unnecessary stops to be made to look for [illegible] nor to instruct all crews to leave empties at a certain stat[illegible] until it is fully supplied; nor to so arrange that the train following [illegible] delay while standing behind train ahead which is unloading or [illegible] at stations nor to instruct any train which is light to move [illegible] cars from blind sidings, because after they are moved, all [illegible]

[illegible], he must give due consideration to branch connections, to [illegible] loads to a junction point to be tied up there until the [illegible] to catch the only [illegible]

[illegible]

[illegible] do [illegible]

[illegible] Chief Train Dispatcher must keep posted fully as to [illegible] be done and should be consulted also as to the [illegible]

[illegible] as Car Distributor for the district, he must com- [illegible] fixed hour each day, from the information furnished over the [illegible], a statement of the number of loaded [illegible] each direction, the number held for unloading, and the [illegible] classes of empties, the number of cars requiring loading [illegible], and other information necessary to form his de- [illegible] well advised as to seasonal movements, as of [illegible] in various ways, of [illegible] industrial plants.

[illegible]

[illegible]

[illegible]

[illegible] of trains; anticipate dangerous con[illegible], [illegible] orders and issuing clear instructions; send out meeting and waiting orders for trains before they reach the meeting point. [illegible] time-table superiority is interfered, with or does not apply and [illegible] room for doubt, he should issue special instructions as to [illegible] shall take the siding at the place of meeting. He must [illegible] entirely upon the order signal to hold a train during [illegible] er; not the unsupported statement of an operator. He [illegible] score each word and figure of a train order the instant it [illegible], require the operators to report trains promptly; avoid [illegible] sensational reports or statements; investigate further before [illegible].

[illegible] an inferior train must wait [illegible] at the [illegible] ting point, a reminder of this fact shall be known to pre[illegible]. Reports shall be prepared showing the detail the [illegible] in the movements of trains, errors in train orders or failure [illegible] issue or deliver thereof. Measure must be taken to avoid [illegible] of information. [illegible] "will", "not", [illegible].

[illegible]

[illegible] "[illegible]", [illegible] [illegible] [illegible] [illegible] closer than fifteen minutes; handling [illegible] [illegible], advising of overdue trains, broken [illegible], [illegible] trains, etc. verbally; Ordering a [illegible] "[illegible]" [illegible] an unsafe practice, the [illegible] the absence of protec- [illegible].

[illegible] er must adhere to the time table provision for [illegible] as is reasonable. But physical conditions [illegible] the importance of trains may necessitate occasionally [illegible] trains to take sidings, for instance, where there are [illegible] sidings and the inferior train is loaded heavily while the [illegible] is such that the inferior train [illegible] back out to pass cars.

[illegible] meeting form of orders should be used when practicable [illegible] "right" form. When the latter is used, it often [illegible] minds of the trainmen and engineers, when [illegible]

[illegible]

[illegible]

[illegible] If wires may fail and cause delay to trains at initial [illegible] must instruct operators in writing how many sections [illegible] and prepare for emergency by train orders.

[illegible] has broken down and has the main track [illegible] The sidings near the [illegible] will not be filled by unimportant freight trains; a few sidings [illegible]

[illegible]

[illegible] until instruction can be [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] up [illegible] close to the [illegible] crew to allow all going in one [illegible] to come to wreck and follow the wrecker into [illegible] ing: begin in time to have all [illegible] is cleared.

[illegible] view is [illegible] of proximity of the [illegible]

[illegible]

[illegible]

[illegible] water stations.

[illegible]

[illegible] air train at descending grade. [illegible] double the bill and avoid any misunderst[illegible] [illegible] observe or display markers, or by leaving [illegible] at foot of grade.

[illegible]

[illegible] and receives instructions from [illegible] endent. He is responsible for the assignment and [illegible] of wires and instruments; prompt tran[illegible] [illegible] use of office supplies. He has charge [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

The operator must exercise care in the use of telephone or tele-[illegible], and be ready at all times to receive train orders; refuse un-[illegible] messages--(each message sent and received must show the [illegible] it), preserve messages sent and deliver those received and [illegible] all messages confidential; enclose in sealed envelopes messages [illegible]livery to trainmen on train; report failure of means of communi-[illegible] avoid having employes and other unauthorized persons frequent [illegible]

[illegible] not transmit the signature of a conductor to the train [illegible] signals in the clear position while [illegible] train; nor fail to display order signal [illegible]

[illegible] meeting point with another train, or in any other manner [illegible] superiority, the operator must not repeat or "X" such order [illegible]

[illegible]

[illegible] of the right train to hold and [illegible] signals; make proper inquiry of [illegible] operators who may have cleared the train, before acknowledging [illegible] train is held; regularly and systematically place on file and [illegible] of all clearance cards issued.

[illegible] an Order be addressed to operator, fixing a meeting point [illegible] advance instead, the [illegible] must continue to deliver copies to such trains as must still [illegible] wait at the station. Should a part of the order be annulled [illegible] patcher, the original order still remains in effect and must [illegible] deliver to such as are not [illegible]

[illegible] duplicate and a copy delivered to the engineman and [illegible] be written in ink, with soft black pencil [illegible] could not be read by the poor [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

"[illegible] isons should be discussed with employes in groups of [illegible]

[illegible]

"While the final result [illegible] the employed thinks; [illegible]

[illegible]

"[illegible]

[illegible]

"[illegible] should be published to prevent [illegible]ty. The range of territory [illegible] too great, [illegible] [illegible]ors than of those a [illegible] work will probably be on [illegible]"

COMPARISON OF ERRORS IN CHECKING AND LOADING [illegible]

[illegible]

[illegible]

Stations.	[illegible] handled.	Errors made.	[illegible] per error made
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

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